A TREATISE OF *ASTRONOMY*;

WHEREIN THE

METHOD

FOR FINDING

The PLACES of the SUN's Apogæum; Middle and Apparent Motions; Right Aſcenſions; and the Aſcenſional Differences; at any Moment of Time, either forward or backward, from certain Radical Moments of Time; is ſet forth with great Exactneſs,

In THREE CHAPTERS.

Being the

John [illegible] James

Divided into Three Chapters likewiſe.

The whole SIX CHAPTERS comprehending One Complete

THEORY *of the* SUN:

With EIGHT TABLES, calculated with the greateſt Induſtry and Care;

Neceſſary for determining, with Truth and Expedition, the PLACES ſought.

By *JOHN SHUTTLEWORTH*, M. A.
Prebendary of *Sarum*.

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To the Right Honourable

The Earl of *GRANVILLE*,

Baron of *HAWNES*;

One of His Majeſty's Moſt Honourable PRIVY-COUNCIL.

May it pleaſe Your Lordſhip,

I Have made bold to dedicate this Second Volume of my Treatiſe of Aſtronomy to Your Lordſhip; which, I hope, will meet with a gracious Acceptance, upon the Account of Your former Favours to me, and Your kind Condeſcenſions to me ever ſince; and in regard alſo I had the Honour to preſent Your Lordſhip with the Firſt Volume of it, which led the Way to this Second; which completes the Theory of the Sun.

Perhaps, Your Lordſhip may think it ſtrange, that I have been ſo long in finiſhing this little Work, which only deſcribes the Courſe of One of thoſe Planets, whoſe Motions have uſually been attempted to be accounted for by the Writers of Aſtronomy: But whoſoever ſhall conſider the uncommon Method, and the great Number of Calculations, I muſt have gone thro', in coming to my Determinations, he will not very haſtily accuſe me of Want of Diligence, in proſecuting my Deſign. And I am verily perſuaded, that if the Men of Learning in this way had contented themſelves with ſtudiouſly inquiring into the Motions of fewer Bodies, we might have had ſome more perfect Theories than we have now.

But although no Man's Labour hath been able hitherto to find out Rules for calculating all the Places of the Planets in their ſeveral Changes with Exactneſs; yet ſuch Rules have been delivered, ſo nearly accounting for the real Appearances, as do ſufficiently ſhew, that the heavenly Bodies move in ſome conſtant regular Order.

This ſhews the almighty Power and the conſummate Wiſdom of the Great Creator, who could at firſt place the Sun, Moon and Stars at ſuch Diſtances from each other; and could direct them in their Courſes ſo perfectly well, as that no Alteration has been needful to have been made in any of their Orbits, ſince the World began.

Notwithſtanding GOD, the God of *Iſrael*, hath ſhewn, that he can put a Stop to their Motions; and can even make them move the contrary Way when he pleaſes.

Upon *Joſhua*'s Prayer, God cauſed the Sun and Moon to ſtand ſtill about a whole Day, until the People of *Iſrael* had avenged themſelves of their Enemies: And in the Days of *Hezekiah* King of *Judah*, God cauſed the Sun to return backward Ten Degrees; by which Degrees it had gone down, in the Sun-dial of *Ahaz*, to give *Hezekiah* Aſſurance by that aſtoniſhing Sign, that he would deliver him and the City of *Jeruſalem* out of the Hand of the King of *Aſſyria*: Which Promiſe was fulfilled, when the Angel of the Lord, in one Night, ſmote an hundred and fourſcore and five thouſand in the Camp of the *Aſſyrians*.

Joſhua x. 12.

Iſaiah xxxvii. 6, 7, 8. And xxxviii. 36.

Theſe two great miraculous Deeds are not only recorded in the Holy Scriptures, but they alſo are related by antient Hiſtorians of good Credit: For in Alluſion to theſe two Prodigies, *Herodotus*, ſpeaking of the Reigns of ſeveral former Kings of *Egypt*, thus writes*; "Within this Time the Sun, "contrary to his uſual Courſe, did riſe four "times, namely, twice he roſe on that Side "where he now ſets; and twice he did ſet "on that Side where he now riſes." And thereto he ſubjoins, "Yet nothing was "changed in *Egypt* under theſe Wonders." No! theſe were Miracles, which muſt needs have mightily alarmed all Nations: And accordingly we are expreſsly told, the Princes of *Babylon* ſent Embaſſadors to *Hezekiah*, to

2 Chro. xxxii. 31.

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* Euterpe, lib. ii. p. 48. facie 2da, lin. 10.

to inquire of that wonderful Return of the Sun, backward. They were wrought altogether for the Advantage and Comfort of the People of *Iſrael:* By the Means of the firſt, they gained Time to deſtroy their Enemies, the Kings of the *Amorites*, with their
Exod.xii. 7, 6. Armies; and by the means of the ſecond of
Cha.xiii. 3. 4. them, *Hezekiah* and his People muſt needs
Num. ix. 1. have been mightily relieved under their Fear
3. 5. of the *Aſſyrians*, whoſe haughty Meſſages had highly terrified them. And theſe Miracles, which none but the Creator of the Heavens and the Earth could work, do ſhew, that the God of *Iſrael* is that Great Creator of all created Beings.

As to the Method in Uſe for finding out the Places of the Sun and Moon, at all Moments of Time required, by Tables of Numbers calculated for that Purpoſe, that ſeems to have taken its Riſe from God's Command to *Moſes*, to cauſe the People of *Iſrael* to keep the Service of the Paſſover every Year on the Fourteenth Day of the Firſt Month of their Year, called the Month *Abib*, being the Day in which God, by the Strength of Hand, brought his People out of *Egypt*, out of the Houſe of Bondage: And that Month *Abib*, called alſo *Niſan*, being the Month in which the Sun is in the Sign *Aries* of the Ecliptick; and the Fourteenth Day of that Month being the Fourteenth Day according to the Moon, or from the New of the Moon, as *Joſephus* tells us [in the 3d Book of the Hiſtories of *Joſephus* of the *Jewiſh* Antiquities, Chap. 10.]; therefore the *Jews* were obliged to obſerve the Time of the Spring Equinox, and the New of the Moon, near the Time of the Sun's coming to the firſt Point of the Sign *Aries:* So that the Neceſſity of keeping the Paſſover at the Seaſon preſcribed, muſt of courſe have put them upon forming ſome ſort of Tables, to direct them in making their Obſervations. Conſequently the *Jews* may reaſonably be allowed to be the firſt of all Nations that made uſe of Tables, for readily finding the Places of the Sun and Moon, for their Eccleſiaſtical Purpoſes. And accordingly Mr. *Flamſteed* very learnedly proves, that the Sundial of *Ahaz* is mentioned before any thing of Aſtronomy was reduced into Tables, either by the *Greeks* or *Romans*; and he gives Reaſons to conclude, that the *Aſſyrians*, the *Medes*, and the *Chaldæans*, were taught their Aſtronomy by the captive *Iſraelites*, who were endued with the Skill of making Sundials; and conſequently were not ignorant of the Sun's Orbits, and of the Periodick Motions of the Moon: And he adds, So that perhaps the *Chaldæans* learned their Saron, or the Returns of the Eclipſes of the Moon, after 223 Lunations, or Revolutions of the Moon, from New to New, or from Full to Full, from thoſe Captives *.

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* In Mr. *Flemſteed*'s Prolegomena, Pag. 4, 5, 6.

We may therefore juſtly take Aſtronomy to have been introduced into the World by God's peculiar People, the antient *Jews*; and the Study of it to have been encouraged by the Almighty Maker of all Things made: Which gives me the greater Hopes, that Your Lordſhip will be pleaſed to patronize this Piece; and that Your Lordſhip's unqueſtionable Attachment to our Conſtitution in Church and State, Your undoubted Loyalty to the King and his Family, Your well-known Character for Learning, for the Knowledge of the Polity of all Nations, and for thoſe Talents and Accompliments which recommend Great Men to the higheſt Truſts in the State, will cauſe this Performance of mine to be the better received by all thoſe who wiſh well to the Improvement of Mathematical Sciences, and of Aſtronomy more eſpecially; which the moſt conſiderable Men in all Ages, and in all Parts of the World, have, by common Conſent, as it were, made it their great Concern to inquire into, advance and encourage. I am,

My very Good LORD,

YOUR LORDSHIP'S

Moſt obedient and moſt
humbly devoted Servant,

Saliſbury,
June, 1745.

JOHN SHUTTLEWORTH.

PREFACE.

IN the Three Chapters of my Treatiſe of Aſtronomy, publiſhed, above Six Years ago, which I now call the Firſt Volume of my Aſtronomy; having ſet forth the Lines and Circles deſcribed in explaining thoſe Appearances of the Sun's diurnal and annual Motions; and the diurnal Motions of the Moon and Stars, which are obvious to the Eye of every Obſerver, together with the Syſtems commonly made uſe of to account for thoſe Phænomena; having alſo ſet forth the Difference betwixt the true and the apparent Heights of the Sun, Moon, and Stars, by reaſon of Refraction and Parallax; and the Numbers of Semidiameters of the Earth betwixt the Centres of the Sun, and of the Earth, founded upon ſuch Obſervations and Calculations as then had occurred to me; I now, in this Second Volume, have ſet forth all that I thought needful to be added to the Firſt Volume, to make one intire and complete Theory of the Motion of the Sun.

To be more particular;

In my Fourth Chapter, I determine the true Elevation of the North Pole at Greenwich *(the Northern Latitude of* Greenwich) *to be 51 Degrees 28 Minutes 33 Seconds. And I deſcribe the Species of the Sun's Elliptical Orbit, and the Manner of the Sun's Motions round it, which is called the Sun's apparent annual Motion, together with the ſuppoſed equable Motion of a Body round the Circumference of a Circle equal to the elliptical Orbit, which is called the Sun's middle annual Motion. And by the Application of this middle Motion to the apparent one, the Sun's mean Anomaly and its true Anomaly, and the Equations of its Orbit, are introduced; and the Manner of determining thoſe Equations by the Aſſumption of a Circle, called the Eccentrick, is ſet forth.*

Sun's apparent annual Motion.

Middle annual Motion.

Alſo I give an Account of the Principles and Methods upon which I frame my Tables of the middle Motions of the Sun, and of the Motion of the Apogæum.

Then, taking Four ſeveral meridional Altitudes of the Sun, obſerved by Mr. Flamſteed, *I find the Sun's apparent Places under the Ecliptick at Noon at* Greenwich, *on thoſe four ſeveral Days;* viz. *on the 30th*

Day of January, *on the 27th Day of* May, *on the 14th Day of* July, *and on the 20th Day of* November, *Old Style*, *in the* Julian *Year of Chriſt* 1711.

In my Fifth Chapter, I explain the Sun's right Aſcenſion, and the aſcenſional Difference.

Then I ſet forth the Sun's right Aſcenſion; and the aſcenſional Difference, and the Equation of Time to be ſubſtracted from the equal Time in the Interval of apparent Time betwixt Noon on the ſaid 30th of January, *and Noon at* G *on the ſaid 27th Day of* May, *together with the two Cauſes of the Inequality betwixt the apparent Time and the equal Time in this Caſe: Alſo I ſet forth the Sun's right Aſcenſion, and the aſcenſional Difference, and the Equation of Time to be added to the equal Time in the Interval of apparent Time betwixt Noon on the ſaid 27th Day of* May, *and Noon at* G *on the ſaid 14th Day of* July, *together with the two Cauſes of the Inequality betwixt the apparent Time and the equal Time in this Caſe: And I ſet forth the like Things applicable to Noon at* G *on the ſaid 20th of* November, *in the ſaid Year* 1711; *and the like Things applicable to the 30th Day of* January (*O. S.*), *at* 5 *Hours* 48 *Min.*

57 *Seconds of apparent Time at* G, *in the* Julian *Year of Chriſt* 1712.

And having given Reaſons for judging within what Limits the Apogæum and the Perigæum of the Sun's Orbit muſt have been found in the ſaid Year 1711; *haveing alſo calculated from ſeveral Poſitions and Proceedings, I find the Eccentricity of the Sun's elliptical Orbit, as accommodated to the Semi-axis* 1927500000, *to be* 31877228; *and I find, that the Differences of the Equations of the Sun's Orbit, calculated from that Proportion, agrees ſo exactly with my Determinations of the Sun's apparent Places under the Ecliptick at the Moments of Mr.* Flamſteed's *Obſervations of the Sun's meridional Altitudes in Chap. IV. reſpectively, and with my Accounts of the Quantities of equal Time contained in the Spaces of apparent Time betwixt the Moments made uſe of, as that I conclude the Species of the Sun's elliptical Orbit is rightly ſet forth by the Proportion of the Semi-axis : to the Eccentricity : : as* 1927500000 : 31877228.

In my Sixth Chapter I determine the Diſtances of the Apogæum of the Sun's Orbit, and the Sun's Diſtances from the vernal Equinox, both according to the middle and the apparent Motions; and the Sun's right Aſcenſion *conſion at Noon at* Greenwich, *at the Radices of ſeveral* Julian *Years of Chriſt of apparent Time.*

And I deſcribe a Method of caleulating an Ephemeris of the Sun's daily Geocentrick Motions throughout the Year, and of ſhewing by how much the apparent Days do exceed or fall ſhort of ſo many Days of equal Time.

Alſo, I lay down a Method for determining the Moments of apparent Time of the Sun's Ingreſs into any of the Signs of the Ecliptick.

The Proofs uſed in this Treatiſe are ſo clear to thoſe who have a competent Knowledge in Arithmetick, in Euclid, *and in the three firſt Axioms of plain and ſpherick Trigonometry; and the Obſervations and Rules delivered therein, are ſo fully inſtructive, as that Gentlemen may be ſatisfied of the Reaſons of my Concluſions, and may find out the Sun's apparent Place in the Heavens, at any Moment of apparent Time, without having Recourſe to other Authors any further than is needful to prove the Truth of my Quotations from them.*

As to my Tables;

The Firſt, is a Table of the Places and right Aſcenſion of the Sun at the radical Moments of ſeveral Julian *Years of Chriſt of apparent Time.*

The Second, is a Table of the middle Motions of the Sun in its Orbit, over and above the intire Revolutions; and alſo of the Motion of the Apogæum Eaſtward under the Eccliptick correſponding to the Spaces of Julian *Years deſcribed in the Column on the Left Hand.*

The Third, is a Table of the Sun's middle Motions Eaſtward in its Orbit; and of the Motion of the Apogæum Eaſtward under the Eccliptick from Noon, at the Beginning of the 31*ſt aſtronomical Day of each Month in the Year.*

The Fourth, is a Table of the Sun's middle Motions in its Orbit: and of the Motion of the Apogæum Eaſtward, in Hours, Minutes, Seconds, Thirds, and Fourths.

The Fifth, is a Table of the Equations or Proſthaphæreſes of the Sun's Orbit.

The Sixth, is a Table of the Right Aſcenſions of the Sun.

The Seventh, is a Table of the equal Time taken up whilſt Arches of the equinoctial Circle move under the Semi-Meridian of Greenwich, *by the diurnal Motion.*

The Eighth, is a Table wherein Degrees and Hours, firſt Scruples and Minutes, ſecond Scruples and Seconds, third Scruples and Thirds, are reduced to fourth Scruples.

OF THE MOTION OF THE *SUN.*

CHAP. I.

Of the Latitude of Greenwich, *with the Determination of four apparent Places of the Sun, founded upon the Obſervations of four Meridional Altitudes of the Sun made by Mr.* Flamſteed *in the Julian Year of Chriſt* 1711.

SECT. I.

Firſt Section.

1. MR. *Flamſteed* tells us, that, in the Year of Chriſt 1689. *December* 1. (Old Style) at 19 ho. + 18 min. + 25 ſec. according to aſtronomical Computation, which, according to vulgar Reckoning, was on *December* 2. at 7 ho. + 18 min. + 25 ſec. in the Morning, he obſerv'd, at *Greenwich*, the Pole Star's greateſt

Diſtance from the Zenith to be $40^\circ+50'+45''$ [*Hiſt. Celeſt. Britan.* Vol. 3. p. 114.]

This Diſtance being northward from the Zenith, he adds thereto the Error of his Inſtrument, (his Mural Arch) which, by reaſon of the ſinking of the Wall to which it was faſten'd, he had found to be at that Time $=1'+10''$. And he likewiſe adds hereto another Error in the Diviſions of his Inſtrument, which he had found to be $=15''$.

The Sum of theſe two Errors $(1'+25'')$ being added to the Diſtance obſerv'd, makes that Diſtance $=40^\circ+52'+10''$; which being ſubtracted from 90°, there is left $49^\circ+7'+50''$, for the Pole Star's Altitude, or refracted Altitude, above the Senſible Horizon, at that Time.

This Angle I call the Angle f ♉ D, in ſetting forth my Method of determining the Angles of Refraction by which the heavenly Bodies are ſeen higher than their apparent Heights [in Chap. 2. Sect. 6. Num. 1.]; and, proceeding by my Method us'd in Numbers 1 and 2, and in the Examples following, I find the firſt and biggeſt external Angle (the Angle b D ♉) $=4''+15'''+39''''$; and taking the external Angles upwards to diminiſh gradually by one fourth Scruple, nearly, [as in Chap. 2. Sect. 6. Example 2.] we ſhall have

$$\begin{array}{lrcccccc} & & & '' & & ''' & & '''' \\ \text{the Angles}\left\{\begin{array}{l} 9,\ 3,\ 2 \\ 10,\ 4,\ 3 \end{array}\right. & \begin{array}{c} = \\ = \end{array} & & \begin{array}{c} 4 \\ 4 \end{array} & \begin{array}{c} + \\ + \end{array} & \begin{array}{c} 15 \\ 15 \end{array} & \begin{array}{c} + \\ + \end{array} & \begin{array}{c} 35 \\ 34 \end{array} \\ \hline \text{and their Sum,} & = & & 8 & + & 31 & + & 09 \end{array}$$

This Sum being multiplied by 5, we have the Product $=42''+35'''+45''''$; and the external Angle b D ♈ being much leſs than $30''$, I ſhall take this Product for the Sum of all the external Angles, or for the Angle of Refraction correſponding to the refracted Height of a Star, whoſe Elevation is obſerv'd to be $=49^\circ+7'+50''$, according to what is ſaid above [Chap. 2. Sect. 6. Num. 11.]

Leaſt true Height of the Pole Star obſerv'd by Mr. *Flamſteed.*

Then ſubtracting this Angle of Refraction (or, in a Round Number, ſubtracting 43″) out of 49° + 7′ + 50″, we have the Remainder = 49° + 7′ + 07″ for the apparent Altitude of the Pole Star, as obſerv'd by Mr. *Flamſteed*, as above. And this I ſhall take to have been the true Height of the Pole Star at that Time, the fix'd Stars, at that Height, being allow'd to have no ſenſible diurnal Parallax.

And this was the leaſt true Height of the Pole Star obſerv'd in that Year.

2. Again, Mr. *Flamſteed* tells us, that, in the ſame Year of Chriſt 1689. on the 17th Day of *December*, (Old Style) at 6 ho. + 5 min. + 9 ſec. Afternoon, he obſerv'd at *Greenwich* the Pole Star's leaſt Diſtance from the Zenith to be 36° + 8′ + 0″ [*Hiſt. Celeſt. Britan.* Vol. 3. p. 114.]

This Diſtance being northward from the Zenith, he adds thereto the Error of his Inſtrument occaſion'd by the ſinking of the Wall to which it was faſten'd, which Error he had found to be = 1′ + 10″; and, likewiſe, he adds thereto another Error in the Diviſions of his Inſtrument, which he had found to be = 15″ [as in Num. 1.]

So adding the Sum of theſe two Errors to the Diſtance obſerv'd, that Diſtance becomes = 36° + 09′ + 25″; which being ſubtracted from 90°, there is left 53° + 50′ + 35″ for the Pole Star's refracted Altitude at that Time.

This Angle I call the Angle f ♉ D [as in Num. 1.]

And, proceeding by the Method us'd in Numbers 1. and 2. of Chap. 2. Sect. 6. at the Beginning, and in the Examples following, I find that the firſt, and biggeſt external Angle (the Angle b D ♉) is $=3''+36'''+22''''$.

So taking the external Angles upwards to diminiſh gradually by one fourth Scruple nearly, [as in Chap. 2. Sect. 6. Example 2.] we have

$$\begin{array}{lrcrcrcr} & & & '' & & ''' & & '''' \\ \text{the Angles}\left\{\begin{array}{r} 9,\ 8,\ 2 \\ 10,\ 4,\ 3 \end{array}\right. & \begin{array}{c} = \\ = \end{array} & & \begin{array}{r} 3 \\ 3 \end{array} & \begin{array}{c} + \\ + \end{array} & \begin{array}{r} 36 \\ 36 \end{array} & \begin{array}{c} + \\ + \end{array} & \begin{array}{r} 18 \\ 17 \end{array} \\ \hline \text{and their Sum,} & = & & 7 & + & 12 & + & 35 \end{array}$$

This Sum being multiplied by 5, we have the Product $=36''+02'''+55''''$.

And the external Angle b D ♉ being much leſs than Thirty Seconds, I ſhall take this Product for the Sum of all the external Angles, or for the Angle of Refraction correſponding to the refracted Height of a Star, whoſe Elevation is obſerv'd to be $=53°+50'+35''$, according to what is ſet forth [Chap. 2. Sect. 6. Num. 11. at the End of the 4th Example].

Greateſt true Height of the Pole Star.

Then ſubtracting this Angle of Refraction (36″ in a Round Number) from $53°+50'+35''$, we have the Remainder $=53°+49'+59''$ for the greateſt apparent Altitude (and alſo for the greateſt true Altitude) of the Pole Star, as obſerv'd by Mr. *Flamſteed*, as above; ſo we have the Sum of the greateſt and of the leaſt true Altitude of the Pole Star, $=102°+57'+06''$; the Half of this $=51°+28'+33''$.

Northern Latitude of *Greenwich.*

This I ſhall take to be the true Elevation of the North Pole at *Greenwich*, or the northern Latitude of *Greenwich*, and of *London*.

Height of the Equinoctial above the Horizon of *Greenwich.*

And, ſubtracting this Latitude out of 90°, we have the Remainder $=38°+31'+27''$ for the Altitude of the Equinoctial Circle above the Rational Horizon of *Greenwich*, or of *London*.

3. Let the Ellipſis A F B G (in 1ſt, 2d, 3d, and 4th Figures) be the Sun's elliptical Orbit, in whoſe Circumference the Sun moves from Weſt to Eaſt (*in conſequentia*) from A through F, B, and G, orderly, and at ſuch a Rate, as to paſs all round that Orbit in the Space of a Sidereal Year.

[See the Figures below at the End of the 5th Chapter.]

The Line B T C Φ A is the tranſverſe Axis, T is the lower Focus, Φ is the upper Focus, C is the Centre, F C G, drawn through C at Right Angles to A B, is the conjugate Axis, A is the *Apogæum*, and B is the *Perigæum* of this elliptical Orbit; the Centre of the Earth is at the Point T.

Let the Ellipſes in each of the Figures be of the ſame Species, and equal to one another; the Orbit is in the Plane of the Ecliptick, T being the Centre of it.

In the 1ſt Figure, betwixt the Half of the tranſverſe Axis C A, and the Half of the conjugate Axis C F, take the middle Proportional T E, and with the Radius T E, from the Centre T deſcribe the Circle E a I b, cutting the Ellipſe in a and b: This Circle is equal to the Ellipſe, [as in Proof for Chap. 1. Sect. 7. Num. 10.]

Let a Body be ſuppos'd to ſet out from the Point E, at the ſame Moment that the Sun ſets out from its *Apogæum* A, and let this Body be ſuppos'd to move orderly through the Points *v*, a, I, and b, ſo as to move all round the Circumference of this Circle in the Space of a Sidereal Year, and to move round it by an equable Motion, whilſt in the mean time the Sun moves in the Circumference of the Ellipſe ſo as to form elliptical Areas from the lower Focus T, equal to the Sectors of the Circle form'd by the Motion of the Body deſcrib'd, in all Intervals of Time.

4. Let the Angles E T ν, E T g, in the Semicircle E a I, be given, determining the Diſtance of the Body eaſtward from the Point E, that is, determining the Sun's Places at the Points ν and g, according to the middle Motion ſpoken of, [Chap. 1. Sect. 7. Num. 2.] at ſome Moments of Time reſpectively; and let the Sectors E T ν, E T g, be equal to the elliptical Areas A T δ, A T γ, form'd by the Sun's apparent Motion eaſtward from the *Apogæum* A to the Points of its Orbit δ and γ reſpectively.

Sun's mean Anomaly.

The Angle E T ν is call'd the Sun's mean Anomaly correſponding to the Angle A T δ, which is call'd the Sun's true Anomaly.

True Anomaly.

So, likewiſe, the Angle E T g is call'd the Sun's mean Anomaly correſponding to the Angle A T γ, which is call'd the Sun's true Anomaly, in the Sun's Deſcent from the *Apogæum* to the *Perigæum*.

The Sector E T ν here being = the elliptical Area A T δ, by taking out the Sector E T r from both Sides, we have left on the one Side the Sector r T ν = the curvilinear Trapezium E A δ r on the other Side.

And the Sector E T g being equal to the elliptical Area A T γ, by taking the Sector E T S from both Sides, we have left on the one Side the Sector S T g = the great curvilinear Triangle E a A — little curvilinear Triangle s a γ on the other Side.

For the Sector E T g = trapezional E a γ T + little curvilinear Triangle s a γ + Sector s T g. And the elliptical Area A T γ = trapezional E a γ T + great curvilinear Triangle E a A.

So ſubtracting trapezional E a γ T, from both Sides, we have the Sector S T g + little curvilinear Triangle s a γ = great curvilinear Triangle E a A; ſo tranſpoſing, we have the Sector s T g

= great curvilinear Triangle E a A — little curvilinear Triangle s a γ.

Let T δ cut the Arch E ν in r, and let T γ, produced, cut the Arch E a g in s.

Equations of the Sun's Orbit.

5. The Angles r T ν, and S T g, are call'd the Equations of the Sun's Orbit correſponding to the mean Anomalies E T ν and E T g, being to be ſubtracted from thoſe mean Anomalies, to leave the Remainders A T δ and A T γ for the Sun's true Anomalies reſpectively in the Sun's Deſcent from the *Apogæum* of its Orbit A, to the *Perigæum* of its Orbit B; becauſe in that Deſcent the Sun's apparent Motion, both under the Ecliptick, and in its Orbit, is leſs than its middle Motion [Chap. 1. Sect. 7. Numbers 2, 9, and 10.].

6. Let the Angles I T h, and I T o, in the Semicircle I b E, be given, determining the Diſtance of the Body eaſtward from E, that is to ſay, determining the Sun's Places at h and o according to the middle Motion ſpoken of [in Num. 2.] at ſome Moments of Time reſpectively; and let the Sectors I T h, I T o, be equal to the elliptical Areas B T m, B T n, form'd by the Sun's apparent Motion eaſtward from the *Perigæum* B to the Points of its Orbit m and n reſpectively.

Let T n cut the Arch o E in σ.

Sun's mean Anomaly.

The Semicircle E a I (180° or 6 Signs) + Angle I T h, is call'd the Sun's mean Anomaly, correſponding to 6 Signs + Angle B T m, which is call'd the Sun's true Anomaly.

Sun's true Anomaly.

So likewiſe 6 Signs + Angle I T o, is call'd the Sun's mean Anomaly, correſponding to 6 Signs + Angle B T n, which is call'd the true Anomaly of the Sun in its Aſcent from the *Perigæum* to the *Apogæum*.

Here the Sector I T h being equal to the elliptical Area B T m, by taking out the elliptical Area B T k from both Sides, we have left on the one Side the elliptical Area k T m = the curvilinear Trapezium I B k h on the other.

And the Sector I T o being equal to the elliptical Area B T n, by taking out the elliptical Area B T β from both Sides, we have left, on the one Side, the elliptical Area β T n, equal to the great curvilinear Triangle I B b — the little curvilinear Triangle o b β.

For the Sector I T o = trapezional b B T o + great curvilinear Triangle I B b; and the elliptick Area B T n = trapezional b B T o + little curvilinear Triangle o b β + elliptick Area β T n.

So ſubtracting the Trapezium b B T o from both Sides, we have the great curvilinear Triangle I B b on the one Side = little curvilinear Triangle o b β + elliptical Area β T n on the other Side; ſo tranſpoſing, we have the elliptick Area β T n = great curvilinear I B b — little curvilinear Triangle o b β.

Let T u cut the Orbit in m, and let T h cut the Orbit in k.

Equations of the Sun's Orbit.

7. The Angles h T u, and β T σ, are call'd the Equations of the Sun's Orbit correſponding to the mean Anomalies 6 Signs + Angle I T h, and 6 Signs + Angle I T o, being to be added to thoſe mean Anomalies to give the Sums 6 Signs + Angle B T m, and 6 Signs + Angle B T n, for the Sun's true Anomalies reſpectively, in the Sun's Aſcent from the *Perigæum* of its Orbit B, to the *Apogæum* of its Orbit A; becauſe in that Aſcent the Sun's apparent Motion, both under the Ecliptick, and in its Orbit, is greater than its middle Motion [Chap. 1. Sect. 7. Num. 2, 9, and 10.]

In the 1ſt Figure, draw T γ in the Plane of the Sun's Orbit, cutting the Ecliptick in γ.

Eccentrick Circle.

8. In the 2d, 3d, and 4th Figures, with the Radius C A, deſcribe the Circle A ξ B x round the Centre C; C A here being = C A in the 1ſt Figure.

I call this Circle the eccentrick Circle.

In the 2d Figure, from the Centre C, draw the Line C N, cutting the Eccentrick in N ſo as to make the Angle A C N equal to the given Angle E T ν in the 1ſt Figure.

And, in the 3d Figure, from the Centre C, draw the Line C N, cutting the Eccentrick in N ſo as to make the Angle A C N equal to the given Angle E T g in the 1ſt Figure.

From T, in the 2d and 3d Figures, let the Line T Q be drawn, ſo as to make the Portion of the Eccentrick A T Q equal to the Sector A C N: From Q draw Q θ, cutting the tranſverſe Axis A B at Right Angles in θ, and cutting the Arch of the Ellipſe in the Point ρ, and draw T ρ: Draw alſo T k parallel to C N, cutting the Eccentrick in k.

So the Arch A T k, in the 2d Figure, = Angle E T ν in the 1ſt Figure; and ſo the Angle A T k, in the 3d Figure, = Angle E T g in the 1ſt Figure.

In the 1ſt Figure, let the *Apogæum* of the Sun's Orbit, A, be at a Diſtance eaſtward from the Beginning of the Sign ♈ of the Ecliptick, in the given Angle ♈ T A, at ſome Moment of Time.

First Note.

Note here, 1. If the Sun, according to its middle Motion, and in its Deſcent from the *Apogæum* to the *Perigæum*, be at the Point ν of the Circle in the given Angle γ T ν, at the ſame Moment of Time; then ſubtracting the Angle

♈ T E from the Angle ♈ T ν, we have the remaining Angle E T ν for the mean Anomaly at that Moment of Time [according to Num. 4. above.]

In like manner, if the Sun, according to its apparent Motion, and in its Deſcent from the *Apogæum* to the *Perigæum*, be at the Point δ of its Orbit, in the given Angle ♈ T δ, at the ſame Moment of Time, then ſubtracting the Angle ♈ T A from the Angle ♈ T δ, we have the remaining Angle A T δ for the Sun's true Anomaly at that Moment of Time, [according to Num. 4. above.]

Second Note.

Note here, 2. If the Sun, according to its middle Motion, and in its Aſcent from the *Perigæum* to the *Apogæum*, be at the Point h of the Circle, in the given Angle I T H, not exceeding the Angle I T ♈ at the ſame Moment of Time; then ſubtracting the Angle ♈ T E from 12 Signs — Angle h T ♈, we have the Remainder = 6 Signs + Angle I T h for the mean Anomaly at the Moment of Time at which the Angle ♈ T E is given, [according to Num. 6. above.]

In like manner, if the Sun, according to its apparent Motion, and in its Aſcent from the *Perigæum* to the *Apogæum*, be at the Point m of its Orbit, in the given Angle B T m, not exceeding the Angle B T ♈ at the ſame Moment of Time; then ſubtracting the Angle ♈ T A from 12 Signs — Angle m T ♈, we have the Remainder = 6 Signs + Angle B T m, for the Sun's true Anomaly at that Moment of Time, [according to Num. 6. above.]

Third Note.

Note here, 3. If the Sun, according to its middle Motion, and in its Aſcent from the *Perigæum* to the *Apogæum*, be at the Point o of the Circle, in the given Angle I T o, exceeding the Angle I T ♈ at the ſame Moment of Time, then ſubtracting the Angle ♈ T E — Angle ♈ T o given, from 12 Signs, we have the Remainder = 6 Signs + Angle I T o for the mean Anomaly at the Moment of Time at which the Angle ♈ T E is given, [according to Num. 6. above.]

In like manner, if the Sun, according to its apparent Motion, and in its Aſcent from the *Perigæum* to the *Apogæum*, be at the Point n of its Orbit, in the given Angle B T n, exceeding the Angle B T ♈ at the ſame Moment of Time, then ſubtracting the Angle ♈ T A — Angle ♈ T n given, from 12 Signs, we have the Remainder = 6 Signs + Angle B T n for the Sun's true Anomaly at that Moment of Time, [according to Num. 6. above.]

9. It being neceſſary, for expeditiouſly finding out the Sun's Place under the Eclipticck at any Moment of Time requir'd, to have Tables at Hand of the middle Motions of the Sun, and of the Motions of the *Apogæum* in any determinate Numbers of Years, Days, Hours, Minutes, &c. accordingly, I have compos'd ſuch Tables, which are ſubjoin'd at the End of this Volume: And becauſe it may be ſatisfactory to my Readers to know the Principles and Methods upon which, and by which I act, in framing thoſe Tables, I ſhall here underneath give an Account of them.

In the firſt Place, I conſider, that in a Sidereal Year there are 365 Days + 6 Hours + 9 Minutes + 14 Seconds, = 113609354400 Fourths; and that in this Space of Time the Sun paſſes eaſtward throughout the whole Circumference of its Orbit; and that in Conjunction with the ſlow Motion of its Orbit eaſtward, likewiſe, it returns to be in Oppoſition to thoſe Stars in the Semicircle of Latitude, which it was in Oppoſition to at the Beginning of the Sidereal Year, [Chap. 1. Sect. 6. Num. 9.]

And I conſider, that, in a Tropical Year, there are 365 Days + 5 Hours + 48 Minutes + 57 Seconds, and that in this Space of Time the Sun moves eaſtward through $359^{\circ} + 59' + 10' + 01''' + 17'''' +$ of its Orbit, by the middle Motion; and that the Sun's *Apogæum*, together with the Sun's Orbit, and the ſtarry Sphere, move eaſtward under the Ecliptick through the ſmall Arch of it, of $49'' + 58''' + 43'''$ in that Space of Time; ſo by the joint Motions of the Sun in its Orbit, and of the Sun's *Apogæum*, the Sun moves all round under the Ecliptick in the Space of a Tropical Year [Chap. 1. Sect. 6. Num. 10.]

Upon theſe Foundations I build my Tables of the Sun's middle Motions in its Orbit, and of the Motions of the Sun's *Apogæum*, by calculating as follows:

As the Space of a Sidereal Year (as $113609354400''''$) : to 1 *Julian* Year of 365 Days (to $113529600000''''$) :: ſo 360° (ſo $4665600000''''$) : to $4662324722'''',7958897 + = 359^{\circ}+44'+50''+12'''+02''',7958897 +$.

This is the Sun's middle Motion in its Orbit in 365 Days.

And as 113609354400 Fourths : to 1 Day (to 311040000 Fourths) :: ſo $4665600000''''$: to $12773492'''',3912216 + = 59' + 08'' + 11''' + 32'''',3912216 +$.

This is the Sun's middle Motion in its Orbit in 1 Day.

And as 113609354400 Fourths : to 1 Hour (to 12960000 Fourths) :: ſo $4665600000''''$: to $532228'''',8496342 + = 2' + 27'' + 50'' + 28'''',8496342 +$.

This is the Sun's middle Motion in its Orbit in 1 Hour.

Then, As the Space of a Sidereal Year (113609354400 Fourths) : to the Space of a Tropical Year (113604973200 Fourths) : ſo 360° (ſo $4665600000''''$) : $4665420077'''',0805542 + = 359^\circ + 59' + 10'' + 01''' + 17'''',0805542+$.

This is the Sun's middle Motion in its Orbit in a Tropical Year.

And as 113609354400 Fourths : to 20 Min. + 17 ſec. (to 4381200 Fourths) : : ſo $4665600000''$: to $179922'''',9194458 - = 49'' + 58''' + 42'''',9194458-$.

This is the Sun's middle Motion in its Orbit in 20 Minutes + 17 Seconds, in the Difference in Time by which the Sidereal Year exceeds the Tropical Year; and this is the Motion of the Sun's *Apogæum*, and of the Motion of the Sun's Orbit, and of the Line of Apſes alſo, together with the Motion of the ſtarry Sphere eaſtward under the Ecliptick in the Space of a Tropical Year, [Chap. 1. Sect. 6. Num. 10.]

And for the Motions of the Sun's *Apogæum* under the Ecliptick, As the Space of a Tropical Year (113604973200 Fourths) : to 1 *Julian* Year of 365 Days (to 113529600000 Fourths) : : ſo the Motion of the Sun's *Apogæum* in a Tropical Year (ſo $179922'''',9194458 -$) $179803'''',5464482 + = 49'' + 56''' + 43'''',5464482+$.

This is the Motion of the Sun's *Apogæum* eaſtward under the Ecliptick in the Space of 365 Days.

And as 113604973200 Fourths : to 1 Day (to 311040000 Fourths) : : ſo $179922'''',9194458$: $492'''',6124560 + = 8'' + 12''',6124560+$.

This is the Motion of the Sun's *Apogæum* eaſtward under the Ecliptick in the Space of 1 Day.

And as 113604973200 Fourths : to 1 Hour (to 12960000 Fourths) :: ſo $179922''''$,9194458 : $20''''$,5255190; this is the Motion of the Sun's *Apogæum* eaſtward under the Ecliptick in the Space of 1 Hour.

And there is no need of Calculation for finding the Sun's middle Motion in its Orbit, or for finding the Motion of the Sun's *Apogæum* under the Ecliptick for Minutes, for Seconds, for Thirds, or for Fourths; becauſe 1 Minute being the 60th Part of one Hour, and 1 Second being the 60th Part of one Minute, and ſo on; thoſe Numbers which are Degrees in the Motions corresponding to Hours, they will be prime Scruples in the Motions correſponding to Minutes; and they will be ſecond Scruples in the Motions correſponding to Seconds; and ſo on.

And the Table of theſe Motions is ſo order'd, as that, at one View, the Motions correſponding reſpectively to Minutes, to Seconds, to Thirds, and to Fourths, are diſtinctly ſeen.

Likewiſe, it being neceſſary, for expeditiouſly ſuiting the Equations of the Sun's Orbit to their correſponding mean Anomalies, to have a Table at hand of thoſe Equations; accordingly, I have compos'd ſuch a Table, which I have put among my Tables at the End of this Volume; and, for the Satisfaction of my Readers, I have deſcrib'd upon what Principles I have proceeded in filling that Table, and have given Directions, in my Examples, for the Uſe of thoſe Equations, [Chap. 5. Sections 4, and 5.]

SECT.

SECT. II.

1. IN the *Julian* Year of Chriſt 1711, on the 30th Day of *January* (*Old Style*) at 00 aſtronomical Hour, but at the 12th Hour, according to common Computation, the corrected Diſtance of the Sun's remote Limb from the Vertex was $66^{\circ}+10'+40''$; and on the ſame Day, at 00 aſtronomical Hour + 2 Min. + 16 Sec. the corrected Diſtance of the Sun's neareſt Limb from the Vertex, was $65^{\circ}+38'+40''$, upon the Semi-meridian of *Greenwich* [as in the 2d Volume of *Flamſteed*'s Obſervations.] Second Section.

The Difference betwixt thoſe two Diſtances, $=32'$ and the Half Difference $=16'$; ſo adding theſe $16'$ to the Diſtance of the neareſt Limb, we have the Diſtance of the Sun's Centre ſouthward from the Zenith at the Time of Obſervation $=65^{\circ}+54'+40''$.

So that at Noon, on the ſaid 30th Day of *January*, the refracted Altitude of the Sun's Centre above the Senſible Horizon of *Greenwich*, was $=24^{\circ}+05'+20''$, which did exceed the Sun's apparent Height by the Angle of Refraction, as is ſet forth above, [in Chap. 2. Sect. 1. Num. 4.]

Then calculating by my Method, [in Chap. 2. Sect. 6. Num. 1, and 2.] I find the biggeſt external Angle (the Angle bD♉) $=11''+01'''+42''''$.

And proceeding according to the Continuation of that Method, I find

the external Angle $9,3,2=10''+59'''+54''''$
and the external Angle $10,4,3=10''+59'''+50''''$

and the Sum of theſe two Angles $=21+59+44$.

And this Sum being multiplied by 5, we have the Product $= 1'+49''+58'''+40''''$.

And becauſe the external Angle b D ♑ is leſs (and very conſiderably leſs) than 30 Seconds, I ſhall take this Product for the Angle of Refraction correſponding to the refracted Altitude, $= 24^\circ+05'+20''$, according to what is ſet forth above, [in Chap. 2. Sect. 6. Exam. 4. Num. 11.]

So ſubtracting this Angle of Refraction out of $24^\circ+05'+20''$, we have the Remainder $= 24^\circ+03'+30''+01'''+20''''$, for the Sun's apparent Height at Noon, at *Greenwich*, at the Beginning of the ſaid 30th aſtronomical Day of *January*.

2. Now the Sun being thought to be in its *Perigæum* when it is nearly under 7° of ♑, or at about one Week after the Winter Solſtice, in this Age, which is about the 17th Day of *December*, and there being 44 Days betwixt the 17th of *December* and the 30th Day of *January* next following, therefore on the Noon of the 30th Day of *January* aboveſaid, the Sun had mov'd eaſtward in its Orbit by the middle Motion, 1 Sign $+13^\circ+22'+00''+27'''+44''''$ [by my Tables], from the Point of the *Perigæum* of its Orbit, and was nearly at its leaſt Diſtance from the Earth.

In the 1ſt Figure for Sect. 2. Num. 2. let the Angle B c m = 1 Sign $+13^\circ+22'+00''+27'''+44''''$, B being the Point of the *Perigæum* of the Sun's circular Orbit, c being the Centre of it, T being the Centre of the Earth, and the Centre of the Ecliptick, and m being the Point of the Orbit in which the Sun was at Noon on the ſaid 30th Day of *January*. Draw T m and c m.

Here putting c m (the Sun's middle Diſtance from the Earth) = 1927500000, we have T c (the Eccentricity of the Sun's Orbit) = 37500000 [as in Sect. 1. Num. 9.]; and having the Angle B c m

B c m $= 43^{\circ} + 22' + 00'' + 27''' + 44''''$, we have the Line T m $=$ 1900414327 of ſuch Parts as give the Semidiameter of the Earth $=$ 70000 [as in the firſt Proof].

Note. But it is to be noted, that the Day of the Year aſſum'd here of the Sun's being in its *Perigæum*, is not to be taken for the certain fix'd Day of the Sun's being there; this is aſſum'd only for the Sake of nearly finding the Length of the Line T m, and thereby of nearly finding the Sun's diurnal Parallax at Noon on the ſaid 30th Day of *January*.

The like is to be noted for my Aſſumption of the Day of the Year of the Sun's being in its *Apogæum* or *Perigæum* in each of the Sections below. [See the Note in the 1ſt Figure for Chap. 4. Sect. 2. Num. 2.]

Let the Angle f k w (in the 2d Figure for Sect. 2. Num. 2.) $= 24^{\circ} + 03' + 30'' + 01''' + 20''''$ ($=$ the Sun's apparent Height at Noon at *Greenwich* on the ſaid 30th of *January*) [as in Num. 1.] Let the Sun be ſuppos'd to be at the Point w, at the Extremity of the Line k w: From the Centre of the Earth c, draw c w, where c w $=$ T m in the 1ſt Figure for Sect. 1. Num. 3.

Then c w being $=$ 1900414327, and c k (the Earth's Semidiameter) being $=$ 70000, we have the parallactick Angle c w k $= 6'' + 56''' + 05''''$ [as in the 2d Proof]; and adding this parallactick Angle to the Sun's apparent Height above, (to the Angle f k w) we have the Sum $= 24^{\circ} + 03' + 36'' + 57''' + 25''''$ for the Angle F c w; namely, for the Sun's true Height above the Rational Horizon of *Greenwich* at Noon on the ſaid 30th Day of *January*, according to what is ſet forth above [in Chap. 1. Sect. 8. Num. 3. and in Chap. 3. Num. 11, and 12.].

Then ſubtracting this Angle F c w from the Height of the Equinoctial Circle above the Rational Horizon of *Greenwich*, (from $38^{\circ}+31'+27''$) [as in Sect. 1. Num. 2.] we have the Remainder $= 14^{\circ}+27'+50''+02'''+35''''$, for the Sun's Declination ſouthward from the Equinoctial at that Moment of Time.

Firſt PROOF

For Sect. 2. Num. 2.

[*See* Fig. 1. *for* Sect. 2. Num. 2.]

In the Triangle T c m, we have } the Side c m = 1927500000
the Side T c = 37500000

So we have the Sum of thoſe Sides = 1965000000
And the Difference of thoſe Sides = 1890000000

And we have the Angle comprehended between thoſe Sides, the Angle B c m (the Angle T c m) } $= 43^{\circ}+22'+00''+27'''+44''''$

So we have the Sum of the oppoſite Angles (the Sum of the Angles c T m and c m T) } $=136+37+59+32+16$

And the Half Sum of thoſe Angles } $= 68+18+59+46+08$

And the Tangent of the Half Sum of thoſe Angles } = 251501,029

Then, As the Sum of the Sides (1965000000) : to the Difference of the Sides (1890000000) : : ſo the Tangent of the Half Sum of the Angles (251501,029) : 241901,753+; which is the Tangent of $67^{\circ}+32'+24''+52'''+01''''$, which is the Half Difference of the oppoſite Angles.

So ſubtracting this Half Difference of oppoſite Angles from the Half Sum, we have the Remainder $=46'+34''+54'''+07''''$ for the leſſer

Angle c m T [by 4th Caſe of plain oblique-angled Triangles, *Caſwell*].

Then the Sine of $46' + 34'' + 54''' + 07'''' = 1354,967$
And Sine of $43^\circ + 22 + 00 + 27 + 44 = 68666,632$
And as the Sine of c m T (1354,967) : T c (37500000) : : ſo the Sine of T c m (68666,632) : 1900414327+, which is = T m, = the Sun's Diſtance from the Centre of the Earth at the Time of the Obſervation made on the ſaid 30th of *January*, in ſuch Parts as give the Semidiameter of the Earth = 70000.

Second PROOF

For Sect. 2. Num. 2.

[*See* Fig. 2.]

The Angle f k w being $= 24^\circ + 03' + 30'' + 01''' + 20''''$, we have the Angle c k w $(90^\circ + \text{f k w}) = 114^\circ + 03' + 30'' + 01''' + 20''''$; and we have the Sine of this Angle c k w (the Sine of its Supplement) = 91313,0846.
Then as c w (1900414327) : Sine of c k w (91313,0846) : : ſo c k (70000) : 3,3634+, which is the Sine of $6'' + 56''' + 05''''$, which is the Angle c w k [by Caſe 1. of Oblique-angled Triangles, *Caſwell*].

3. The 30th of *January*, in the ſaid Year 1711. was nearly in the Middle of the Space of Time betwixt the Winter Solſtice and the Spring Equinox next following; and the Sun being in the Beginning of the Sign *Capricorn* at the Winter Solſtice, in its Aſcent towards the Sign *Aries*; therefore, on the ſaid 30th Day of *January*, the Sun was ſomewhere under the Quadrant of the Ecliptick betwixt the Beginning of the Sign *Capricorn* and the Beginning of the Sign *Aries*.

In the Figure for Sect. 2. Num. 3. let the Arch ♈P♑ repreſent the Quadrant of the Ecliptick betwixt the Beginning of *Aries* and the Beginning of *Capricorn*; and let the prick-lin'd Arch BAα repreſent a Quadrant of the Equinoctial northward above the Quadrant of the Ecliptick ♈P♑.

Let N be the North Pole of the Equinoctial, and let the Line NAPn repreſent an Arch of the Semi-meridian of *Greenwich* cutting the Arch ♈P♑ in P betwixt ♈ and ♑, the Sun being at P at the Time of Obſervation mention'd: So the Arch NA is a Quadrant cutting the Arch BAα at Right Angles in A[*]; ſo the Triangle PAB is a ſpherical Triangle, right-angled at A, and the Arch PA is perpendicular to the Baſis BA, and the Arch of the Ecliptick ♈P is the Hypothenuſe of the Triangle PAB. Let the two-lin'd Arch HIno be an Arch of the Rational Horizon of *Greenwich* cutting the Equinoctial in I, in the Arch BAα produced beyond α, and cutting the Semi-meridian of *Greenwich* in n below P; ſo the Arch of the Semimeridian $nP = 24^{\circ} + 03' + 36'' + 57''' + 25''''$ (= the Sun's true Height above the Rational Horizon of *Greenwich* at Noon on the ſaid 30th Day of *January*) [as in Num. 2.] and the Arch of the Semimeridian $PA = 14^{\circ} + 27' + 50'' + 02''' + 35''''$ (= the Sun's Declination ſouthward from the Equinoctial at Noon on the ſaid 30th of *January*) [as in Num. 2.]

So in the ſpherical Triangle PAB, having the Leg $PA = 14^{\circ} + 27' + 50'' + 02''' + 35''''$, and having the Angle oppoſite that Leg $= 23^{\circ} + 28' + 54''$, [as in Chap. 3. Num. 13.] we have the Hypothenuſe $♈P = 38^{\circ} + 49' + 04''$ [as in the Proof].

Then

[*] *Caſw.* Spheric. Trigonom. Num. 19.

Then ſubtracting this from 90°, we have the Remainder = 51° + 10′ + 56″ for the Arch ♑ ♒ P; and out of this ſubtracting 30°, we find, that, at Noon at *Greenwich*, on the 30th Day of *January*, (*Old Style*) in the *Julian* Year of Chriſt 1711. the Sun, at P, was under 21° + 10′ + 56″ of ♒, (of *Aquarius*) according to its apparent Motion.

Sun's Place at Noon *January* 30, 1711.

PROOF

For Sect. 2. Num. 3.

The Angle P B A = 23° + 28′ + 54″, and the Sine of it = 39845,58.
The Leg P A = 14° + 27′ + 50″ + 02‴ + 35⁗, and the Sine of it = 24976,99
Then, As the Sine of P B A (39845,58) : Sine of P A (24976,99) :: ſo Radius (100000,00) : 62684,47— = Sine of 38° + 49′ + 04″, which is = the Hypothenuſe ♈ P [by Caſe 10. of Right-angled ſpherical Triangles, *Caſwell*].

SECT. III.

1. IN the *Julian* Year of Chriſt 1711, on the 27th Day of *May*, (*Old Style*) at 00 aſtronomical Hour, (but at the 12th Hour according to common Computation) the corrected Diſtance of the Sun's Centre from the Vertex was 28° + 43′ + 40″ [as in Vol. 2. of *Flamſteed*'s Obſervations].

So that at Noon on the ſaid 27th Day of *May* in 1711, the refracted Altitude of the Sun's Centre above the Senſible Horizon of *Greenwich* was 61° + 16′ + 20′, which did exceed the Sun's apparent Height by the Angle of Refraction, as is above ſaid [Chap. 2. Sect. 1. Num. 4.].

Then calculating by my Method in Chap. 2. Sect. 6. Num. 1, and 2. I find the biggeſt external Angle (the Angle b D ♑) $= 2'' + 42''' + 09''''$.

Now when the refracted Height of a Star is $= 58° + 50' + 30''$, as the external Angles advance upwards from the external Angle b D ♑, they diminiſh gradually by ſomething leſs than one fourth Scruple, as above [Chap. 2. Example 1.]; ſo that here, as the external Angles advance upwards from the Angle b D ♑, they muſt diminiſh gradually by ſomething yet leſs than one fourth Scruple.

So diminiſhing accordingly, and accommodating to the Proceeding in that 1ſt Example, having

$'' \quad ''' \quad ''''$

the external Angle bD♑ $= 2 + 42 + 9$

we may put the external Angle βΔD $= 2 + 42 + 8$

and we may put the external Angle
7,1Δ $= 2 + 42 + 7$
8,2,1 $= 2 + 42 + 7$
9,3,2 $= 2 + 42 + 6$
10,4,3 $= 2 + 42 + 5$

ſo the Sum of the Angles 9,3,2 and 10,4,3 $= 5'' + 24''' + 11''''$.

This Sum being multiplied by 5, we have the Product $= 27'' + 00''' + 55''''$.

This I ſhall take for the Angle of Refraction correſponding to the refracted Altitude $61° + 16' + 20''$, (the Angle b D ♑ being very much leſs than 30 Seconds) [as in Chap. 2. Sect. 6. Num. 11.]

Sun's apparent Height on the 27th of *May*.

So ſubtracting this Angle of Refraction out of $61° + 16' + 20''$, we have the Remainder $= 61° + 15' + 52'' + 59''' + 05''''$, for the Sun's apparent Height at Noon, at the Beginning of the 27th aſtronomical Day of *May*, *(Old Style)* in the *Julian* Year of Chriſt 1711.

2. Now the Sun being thought to be in its *Perigæum* when it is nearly under 7° of *Capricorn*, or about the 17th Day of *December*, and there

being 161 Days betwixt the 17th of *December* and the 27th Day of *May* next ſollowing; therefore, on the Noon of the 27th Day of *May* aboveſaid, the Sun had mov'd eaſtward in its Orbit by the middle Motion, 5 Signs $+08^{\circ}+40'+58''+57'''+54''''$, [by my Tables] from the Point of the *Perigæum* of its Orbit, and was nearly at its greateſt Diſtance from the Earth.

In the 1ſt Figure, for Sect. 2. Num. 2. let the Angle B c n $=5$ Signs $+08^{\circ}+40'+58''+57'''+54''''$.

Then putting and reaſoning as in Sect. 2. Num. 2. we have the Line T n (the Sun's Diſtance from the Centre of the Earth at Noon at *Greenwich* on the ſaid 27th Day of *May*) $=1962540544$ of ſuch Parts as give the Semidiameter of the Earth $=70000$ [ſee the Notes in Sect. 2. Num. 2. and the Figure for Sect. 2. Num. 2.].

Let the Angle f k w (in the 2d Figure for Sect. 2. Num. 2.) $=61^{\circ}+15'+52''+59'''+05''''$, ($=$ the Sun's apparent Height at Noon at *Greenwich* on the ſaid 27th Day of *May*) [as in Num. 1.] Let the Sun be ſuppos'd to be at the Point w, at the Extremity of the Line k w; from the Centre of the Earth, c, draw c w, where c w $=$ T n, in the 1ſt Figure for Sect. 1. Num. 3.

Then c w being $=1962540544$, and c k (the Earth's Semidiameter) being $=70000$, we have the parallactick Angle c w k $=3''+32'''+08''''$ [as in the Proof].

And, adding this parallactick Angle to the Sun's apparent Height, (to the Angle f k w above) we have the Sum $=61^{\circ}+15'+56''+31'''+13''''$ for the Angle F c w, namely, for the Sun's true Height above the Rational Horizon of *Greenwich* at Noon, on the ſaid 27th Day of *May*,

[according to what is ſet forth above, in Chap. 1. Sect. 8. Num. 3. and in Chap. 3. Num. 11, and 12.]

Then ſubtracting $38^\circ + 31' + 27''$ (the Height of the Equinoctial Circle above the Rational Horizon of *Greenwich*) [as in Sect. 1. Num. 2.] from this Angle F c w, we have the Remainder $= 22^\circ + 44' + 29'' + 31''' + 13''''$, for the Sun's Declination northward from the Equinoctial at that Moment of Time.

PROOF

For Sect. 3. Num. 2.

The Angle f k w being $= 61^\circ + 15' + 52'' + 59''' + 05''''$, we have the Angle c k w ($90^\circ +$ f k w) $= 151^\circ + 15' + 52'' + 59''' + 05''''$, and we have the Sine of it, (the Sine of its Supplement) $= 48076,351+$.

Then, As c w (1962540000) : Sine of c k w (48076 351+) : : ſo c k (70000) : 1,7148, which is the Sine of $5'' + 32''' + 08''''$, which is the Angle c w k [by Trigonometry.]

3. The 27th Day of *May*, in 1711. above ſaid, being advanced beyond the Spring Equinox to be about a Fortnight diſtant from the Summer Solſtice, and the Sun being in the Beginning of the Sign *Aries* of the Ecliptick at the Spring Equinox; and being in the Beginning of the Sign *Cancer* at the Summer Solſtice; therefore at the Time of Mr. *Flamſteed*'s Obſervation on the ſaid 27th of *May*, the Sun was pretty much advanced under the Sign *Gemini*.

In the Figure for Sect. 3. Num. 3. let the Arch ♈ ♉ ♊ ♋ repreſent the Quadrant of the Ecliptick betwixt the Beginning of *Aries* and the Beginning of *Cancer*, and let the prick-lin'd

Arch B A ♎ repreſent a Quadrant of the Equinoctial Circle ſouthward below the Quadrant of the Ecliptick ♈ ♉ ♊ ♋.

Let N be the North Pole of the Equinoctial, and let the Line N P A n repreſent an Arch of the Semimeridian of *Greenwich* cutting the Arch of the Ecliptick in P, in the Point the Sun was under at the Moment of Mr. *Flamſteed*'s Obſervation; ſo the Arch N P A is a Quadrant cutting the Arch B A ♎ at Right Angles in the Point A.

So the Triangle P A B is a ſpherical Triangle, right-angled at A, and the Arch P A is perpendicular to the Baſis B A, and the Arch of the Ecliptick ♈ ♉ ♊ P is the Hypothenuſe of the Triangle P A B.

Let the two-lin'd Arch H I n o be an Arch of the Rational Horizon of *Greenwich*, cutting the Equinoctial in I, in the Arch ♎ A B produced beyond B, and cutting the Semimeridian of *Greenwich* in n, ſouthward from A.

So the Arch of the Semimeridian n A P $= 61^\circ + 15' + 56'' + 31''' + 13''''$, as repreſenting the Sun's true Height; and the Arch A P $= 22^\circ + 44' + 29'' + 31''' + 13''''$, as repreſenting the Sun's Declination northward from the Equinoctial at the Noon on the ſaid 27th Day of *May*, [as in Num. 2.]

So in the ſpherical Triangle P A B, having the Leg A P $= 22^\circ + 44' + 29'' + 31''' + 13''''$, and having the Angle oppoſite that Leg $= 23^\circ + 28' + 54''$, [as in Chap. 3. Num. 13.] we have the Hypothenuſe ♈ ♉ ♊ P $= 75^\circ + 58' + 23'' + 33''' + 27''''$, [as in the Proof.]

Then ſubtracting this from 90°, we have the Remainder $= 4^\circ + 01' + 36'' + 26''' + 33''''$, for the Arch P ♋ of the Ecliptick; and ſubtracting this out of 30°, we have the Remainder equal

[according to what is ſet forth above, in Chap. 1. Sect. 8. Num. 3. and in Chap. 3. Num. 11, and 12.]

Then ſubtracting $38^\circ + 31' + 27''$ (the Height of the Equinoctial Circle above the Rational Horizon of *Greenwich*) [as in Sect. 1. Num. 2.] from this Angle F c w, we have the Remainder $= 22^\circ + 44' + 29'' + 31''' + 13''''$, for the Sun's Declination northward from the Equinoctial at that Moment of Time.

PROOF

For Sect. 3. Num. 2.

The Angle f k w being $= 61^\circ + 15' + 52'' + 59''' + 05''''$, we have the Angle c k w ($90^\circ +$ f k w) $= 151^\circ + 15' + 52'' + 59''' + 05''''$, and we have the Sine of it, (the Sine of its Supplement) $= 48076{,}351+$.

Then, As c w (1962540000) : Sine of c k w (48076,351+) : : ſo c k (70000) : 1,7148, which is the Sine of $5'' + 32''' + 08''''$, which is the Angle c w k [by Trigonometry.]

3. The 27th Day of *May*, in 1711. above ſaid, being advanced beyond the Spring Equinox to be about a Fortnight diſtant from the Summer Solſtice, and the Sun being in the Beginning of the Sign *Aries* of the Ecliptick at the Spring Equinox; and being in the Beginning of the Sign *Cancer* at the Summer Solſtice; therefore at the Time of Mr. *Flamſteed*'s Obſervation on the ſaid 27th of *May*, the Sun was pretty much advanced under the Sign *Gemini*.

In the Figure for Sect. 3. Num. 3. let the Arch ♈ ♉ ♊ ♋ repreſent the Quadrant of the Ecliptick betwixt the Beginning of *Aries* and the Beginning of *Cancer*, and let the prick-lin'd

Arch B A *α* repreſent a Quadrant of the Equinoctial Circle ſouthward below the Quadrant of the Eclіptick ♈ ♉ ♊ ♋.

Let N be the North Pole of the Equinoctial, and let the Line N P A n repreſent an Arch of the Semimeridian of *Greenwich* cutting the Arch of the Ecliptick in P, in the Point the Sun was under at the Moment of Mr. *Flamſteed*'s Obſervation; ſo the Arch N P A is a Quadrant cutting the Arch B A *α* at Right Angles in the Point A.

So the Triangle P A B is a ſpherical Triangle, right-angled at A, and the Arch P A is perpendicular to the Baſis B A, and the Arch of the Ecliptick ♈ ♉ ♊ P is the Hypothenuſe of the Triangle P A B.

Let the two-lin'd Arch H l n o be an Arch of the Rational Horizon of *Greenwich*, cutting the Equinoctial in l, in the Arch *α* A B produced beyond B, and cutting the Semimeridian of *Greenwich* in n, ſouthward from A.

So the Arch of the Semimeridian n A P $=$ $61^\circ+15'+56''+31'''+13''''$, as repreſenting the Sun's true Height; and the Arch A P $= 22^\circ+44'+29''+31'''+13''''$, as repreſenting the Sun's Declination northward from the Equinoctial at the Noon on the ſaid 27th Day of *May*, [as in Num. 2.]

So in the ſpherical Triangle P A B, having the Leg A P $= 22^\circ+44'+29''+31'''+13''''$, and having the Angle oppoſite that Leg $=23^\circ+28'+54''$, [as in Chap. 3. Num. 13.] we have the Hypothenuſe ♈ ♉ ♊ P $=75^\circ+58'+23''+33'''+27''''$, [as in the Proof.]

Then ſubtracting this from 90°, we have the Remainder $= 4^\circ+01'+36''+26'''+33''''$, for the Arch P ♋ of the Ecliptick; and ſubtracting this out of 30°, we have the Remainder equal

Sun's Place at Noon *May* 27, 1711.

to $15^\circ+58'+23''+33''+27'''$ of ♊ (of *Gemini*) for the Point of the Ecliptick under which the Sun, at P, was, according to its apparent Motion, at Noon, at *Greenwich*, on the 27th Day of *May*, (*Old Style*) in the *Julian* Year of Chriſt 1711.

PROOF

For Sect. 3. Num. 3.

In the Figure for Sect. 3. Num. 3. the Angle P B A $= 23^\circ+28'+54''$, and the Sine of it $= 39845{,}561$; the Leg P A $= 22^\circ+44'+29''+31'''+13''''$, and the Sine of it $= 38657{,}466$. Then,

As the Sine of P B A (39845,561) : Sine of P A (38657 466) :: ſo Radius (100000,000) : 97018,250 = Sine of $75^\circ+58'+23''+33'''+27''''$, = Sine of Hypothenuſe ♈ ♉ ♊ P, [by Caſe 10 of Right-angled ſpherical Triangles, *Caſwell*]

SECT. IV.

1. IN the *Julian* Year of Chriſt 1711. on the 14th Day of *July*, (*Old Style*) at 00 aſtronomical Hour, (but at the 12th Hour according to common Computation) at Noon, the corrected Diſtance of the Sun's Centre from the Vertex was $31^\circ+40'+20''$ [as in Vol. 2. of *Flamſteed*'s Obſervations].

So that at Noon on the ſaid 14th Day of *July* the refracted Altitude of the Sun's Centre above the Senſible Horizon of *Greenwich*, was $58^\circ+19'+40''$, which did exceed the Sun's apparent Height by the Angle of Refraction, as is ſaid above [Chap. 2. Sect. 1. Num. 4.].

Then calculating by my Method in Chap. 2. Sect. 6. Num. 1, and 2. I find the biggeſt external Angle (the Angle b D ☋) $= 3'' + 3''' + 20''''$.

And taking the external Angles upwards to diminiſh by ſomething leſs than one fourth Scruple, as in Chap. 2. Sect. 6. Exam. 1. and diminiſhing accordingly, and accommodating to the Proceeding in that 1ſt Example, having

the external Angle b D ☋ $= 3'' + 03''' + 20''''$
we may put the external Angle $3\triangle D = 3 + 03 + 19$

and we may put the external Angles $\left\{\begin{array}{l} 7,1\triangle = 3 + 03 + 18 \\ 8,2,1 = 3 + 03 + 17 \\ 9,3,2 = 3 + 03 + 17 \\ 10,4,3 = 3 + 03 + 16 \end{array}\right.$

ſo we have the Sum of the Angles 9,3,2 and 10,4,3 $= 6'' + 06''' + 33''''$; multiplying this Sum by 5, we have the Product $= 30' + 32'' + 45'''$.

This I ſhall take for the Angle of Refraction correſponding to the refracted Altitude $58° + 19' + 40''$, (the Angle b D ☋ being very much leſs than 30 Seconds) [as in Chap. 2. Sect. 6. Num. 11.].

So ſubtracting this Angle of Refraction out of $58° + 19' + 40''$, we have the Remainder $= 58° + 19' + 09'' + 27''' + 15''''$, for the Sun's apparent Height at Noon on the 14th Day of *July*, (*Old Style*) in the *Julian* Year of Chriſt 1711.

2. Now the Sun being thought to be in its *Apogæum* at about the 18th Day of *June* in this Age, and the 14th of *July* being about 26 Days after, the Sun was in its *Apogæum* in the Year 1711; therefore at Noon at *Greenwich*, on that 14th Day of *July*, the Sun had mov'd eaſtward in its Orbit, by the middle Motion, $= 25° + 37' + 33''$, from the Point of the *Apogæum* of its Orbit, and was nearly at its greateſt Diſtance from the Earth.

In the 1ſt Figure for Sect. 2. Num. 2. let the Angle $A c \delta = 25^\circ + 37' + 33''$; then putting and reaſoning as in Sect. 2. Num. 2. we have the Line $T \delta = 1961461443$ of ſuch Parts as give the Semidiameter of the Earth $= 70000$, the Line $T \delta$ being to be taken for the Sun's Diſtance from the Centre of the Earth at Noon at *Greenwich* on the ſaid 14th Day of *July* [See the Notes in Sect. 2. Num. 2. and the 1ſt Figure for Sect. 2. Num. 2.].

Let the Angle f k w (in the 2d Figure for Sect. 2. Num. 2.) $= 58^\circ + 19' + 09'' + 27''' + 15''''$, ($=$ the Sun's apparent Height at Noon at *Greenwich* on the ſaid 14th Day of *July*) [as in Num. 1.]; let the Sun's Centre be ſuppos'd to be at w, at the Extremity of the Line k w; from the Centre of the Earth, c, draw c w, where $c w = T \delta$, in the Figure for Sect. 1. Num. 3.

Then c w being $= 1961461443$, and c k (the Earth's Semidiameter) being $= 70000$, we have the parallactick Angle $c w k = 3'' + 51''' + 51''''$ [as in the Proof].

And, adding this parallactick Angle to the Sun's apparent Height, (to the Angle f k w above) we have the Sum $= 58^\circ + 19' + 13'' + 19''' + 6''''$, for the Angle F c w, namely, for the Sun's true Height above the Rational Horizon of *Greenwich* at Noon, on the ſaid 14th Day of *July* [as in Chap. 3. Numbers 11, and 12.].

Then ſubtracting $38^\circ + 31' + 27''$, (the Height of the Equinoctial Circle above the Rational Horizon of *Greenwich*) [as in Sect. 1. Num. 2.] from this Angle F c w, we have the Remainder $= 19^\circ + 47' + 46'' + 19''' + 06''''$, for the Sun's Declination northward from the Equinoctial at that Moment of Time.

PROOF

PROOF

For Sect. 4. Num. 2.

The Angle f k w being $= 58^\circ + 19' + 09'' + 27''' + 15''''$, we have the Angle c k w $= 148^\circ + 19' + 09'' + 27''' + 15''''$; and we have the Sine of this Angle c k w (the Sine of its Supplement, $31^\circ + 40' + 50'' + 32''' + 45''''$) $= 52518,5255$. Then, As c w (1961461443) : Sine of c k w (52518,5255) : : ſo c k (70000) : 1,8743—, which is the Sine of $3'' + 51''' + 51''''$, which is the Angle c w k, [by Trigonometry].

3. The 14th Day of *July*, in 1711. aboveſaid, being advanced about 34 Days beyond the Summer Solſtice; therefore, at the Time of Mr. *Flamſteed*'s Obſervation on the ſaid 14th Day of *July*, the Sun was ſomewhere near the Sign ♌ (*Leo*) of the Ecliptick.

In the Figure for Sect. 4. Num. 3. let the Arch ♋ ♌ ♍ ♎ repreſent the Quadrant of the Ecliptick betwixt the Beginning of the Sign ♋ and the Beginning of the Sign ♎, and let the prick-lin'd Arch K E α repreſent a Quadrant of the Equinoctial ſouthward below the Quadrant of the Ecliptick ♋ ♌ ♍ ♎.

Let N be the North Pole of the Equinoctial, and let the Line N Q E N repreſent an Arch of the Semimeridian of *Greenwich* cutting the Arch ♋ ♌ ♍ ♎ in Q, in the Point the Sun was under at the Moment of Mr. *Flamſteed*'s Obſervation; ſo the Arch N Q E is a Quadrant cutting the Quadrant K E α at Right Angles in the Point E. So the Triangle Q E K is a ſpherical Triangle, right-angled at E, and the Arch Q E is perpendicular to the Baſis K E, and the Arch Q ♍ ♎ is the Hypothenuſe of the Triangle Q E K.

Let the two-lin'd Arch O n H l be an Arch of the Rational Horizon of *Greenwich*, cutting the Equinoctial in l, in the Arch α E K produced beyond K, and cutting the Semimeridian of *Greenwich* in n, ſouthward from E.

So· the Arch of the Semimeridian n E Q $= 58^{\circ}+19'+13''+19'''+06''''$, as repreſenting the Sun's true Height above the Rational Horizon of *Greenwich*, and the Arch Q E $= 19^{\circ}+47'+46'+19''+06''''$, as repreſenting the Sun's Declination northward from the Equinoctial, at the Noon on the ſaid 14th Day of *July* [as in Num. 2.].

So in the ſpherical Triangle Q E K, having the Leg Q E $= 19^{\circ}+47'+46''+19'''+06''''$, and having the Angle oppoſite that Leg $= 23^{\circ}+28'+54''$, [as in Chap. 3. Num. 13.] we have the Hypothenuſe Q ♍ ♎ $= 58^{\circ}+12'+30''+19'''+45''''$ [as in the Proof].

Sun's Place at Noon on *July* 14, 1711.

Then ſubtracting this Hypothenuſe from 90°, we have the Remainder $= 31^{\circ}+47'+29''+40'''+15'''$ for the Arch Q ♋ of the Ecliptick; and out of this ſubtracting the Arch ♋ ♌, (30°) we have the Point Q in $1^{\circ}+47'+29''+40'''+15''''$ of ♌, (*Leo*) which was the Point of the Ecliptick under which the Sun, at Q, was, according to its apparent Motion, at Noon, at *Greenwich*, on the 14th Day of *July (Old Style)* in the *Julian* Year of Chriſt 1711.

PROOF

For Sect. 4. Num. 3.

In the Figure for Sect. 4. Num. 3. the Angle QKE $=23^{\circ}+28'+54''$, and the Sine of it $=39845{,}561$; the Leg Q E $= 19^{\circ}+47'+46''+19'''+06''''$, and the Sine of it $= 33867{,}541$. Then

As the Sine of Q K E (39845,561) : Sine of Q E (33867,541) : : ſo Radius (100000) : 84997,02[illegible], = Sine of 58°+12′+30″+19‴+45⁗, = the Hypothenuſe ♎ ♍ Q, [by Caſe 10. of Right-angled ſpherical Triangles, *Caſwell*].

SECT. V.

1. IN the *Julian* Year of Chriſt 1711, on the 20th Day of *November* (*Old Style*) at 00 aſtronomical Hour, (but at the 12th Hour at Noon, at *Greenwich*, according to common Computation) the corrected Diſtance of the Sun's remote Limb ſouthward from the Zenith, was 73° +30′+40″; and the corrected Diſtance of the Sun's neareſt Limb ſouthward from the Zenith, was 72°+58′+00″ [as in the 2d Volume of *Flamſteed*'s Obſervations].

The Difference between thoſe two Diſtances was 32′+40″, and the Half Difference is 16′+20″; ſo adding theſe 16′+20″ to the Diſtance of the neareſt Limb, we have the Sum = 73°+14′ +20″, for the Diſtance of the Sun's Centre ſouthward from the Zenith of *Greenwich* at the Time of Obſervation.

So ſubtracting from 90°, we have the refracted Altitude of the Sun's Centre above the Senſible Horizon of *Greenwich* at the Noon on the ſaid 20th Day of *November* = 16°+45′+40″, which did exceed the Sun's apparent Height by the Angle of Refraction, as is ſet forth above [Chap. 2. Sect. 1. Num. 4.].

Then calculating by my Method, [in Chap. 2. Sect. 6. Num. 1, and 2.] I find the biggeſt external Angle (the Angle b D ♑) = 16″+20‴ +42⁗; and the next leſs external Angle (the Angle β △ D) = 16″+19‴+51⁗. So orderly I find the Angle 7, 1, △ = 16″+19‴+02⁗, and the Angle 8,2,1 $= 16'+18'''+14''''$, and the Angle 9,3,2 $= 16''+17'''+27''''$, and the ſixth external Angle (the Angle 10,4,3) $= 16''+16'''+40''''$.

$$\text{So having the Angles}\left\{\begin{array}{l} 9,3,2 = \overset{''}{16}+\overset{'''}{17}+\overset{''''}{27} \\ 10,4,3 = 16+16+40 \end{array}\right.$$

$$\overline{\text{we have the Sum of theſe} = 32+34+07}$$

This Sum, multiplied by 5, gives the Product $= 2'+42''+50'''+35''''$.

And becauſe the external Angle b D ♑ is conſiderably leſs than 30 Seconds, I ſhall take this Product for the Angle of Refraction correſpondent to the refracted Altitude, $= 16°+45'+40''$ [from Chap. 2. Sect. 6. Example 4. Num. 11.].

So ſubtracting this Angle of Refraction out of $16°+45'+40''$, we have the Remainder $= 16°+42'+57''+09'''+25''''$, for the Sun's apparent Height at Noon, at *Greenwich*, on the 20th Day of *November* (*Old Style*) in the *Julian* Year of Chriſt 1711.

2. Now the Sun being thought to be in its *Apogæum* at about the 18th Day of *June* in this Age, and betwixt the Beginning of the 18th aſtronomical Day of *June*, and the Noon on the ſaid 20th of *November*, there were 155 Days, in which Space of Time the Sun had mov'd eaſtward in its Orbit, by the middle Motion, $= 5$ Signs $+02°+46'+09''+48'''+41''''$.

In the 1ſt Figure for Sect. 2. Num. 2. let the Angle A c $\gamma = 5$ Signs $+ 02°$ (152°) $+ 46' + 09''+48''+41''''$; then putting and reaſoning as in Sect. 2. Num. 2. we have the Line T $\gamma =$ 1894237041 of ſuch Parts as give the Semidiameter of the Earth $= 70000$, the Line T γ being to be taken for the Sun's Diſtance from the

the Centre of the Earth at Noon at *Greenwich* on the ſaid 20th Day of *November* [ſee the *Note* in Sect. 2. Num. 2.].

Let the Angle f k w (in the 2d Figure for Sect. 2. Num. 2.)$=16^\circ+42'+57''+09'''+25''''$, (the Sun's apparent Height at Noon at *Greenwich* on the ſaid 20th Day of *November*) [as in Num. 1.] let the Sun's Centre be ſuppos'd to be at w, at the Extremity of the Line k w. From the Centre of the Earth, c, draw c w, where c w $=$ T γ, in the Figure for Sect. 1. Num. 3.

Then c w being $= 1894237041$, and c k being $=70000$, we have the parallactick Angle c w k $=7''+17'''+51''''$ [as in the Proof].

And adding this parallactick Angle to the Sun's apparent Height, (to the Angle f k w above) we have the Sum $=16^\circ+43'+04''+27'''+16''''$ for the Angle F c w, namely, for the Sun's true Height above the Rational Horizon of *Greenwich* at Noon on the ſaid 20th Day of *November* [as in Chap. 3. Numbers 11, and 12.].

Then ſubtracting $38^\circ+31'+27''$ (the Height of the Equinoctial Circle above the Rational Horizon of *Greenwich*) [as in Sect. 1. Num. 2.] from this Angle F c w, we have the Remainder $=21^\circ+48'+22''+32'''+44''''$ for the Sun's Declination ſouthward from the Equinoctial at that Moment of Time.

PROOF

For Sect. 5. Num. 2.

The Angle f k w being $=16^\circ+42'+57''+09'''+25''''$, we have the Angle c k w $=106^\circ+42'+57''+09'''+25''''$; and we have the Sine of this Angle c k w (the Sine of its Supplement $73^\circ+17'+02''+50'''+35''''$) $=95774{,}2823$.

Then, As c w (1894237041) : Sine of c k w (95774,2823) : : ſo c k (70000) : 3,5393,— which is the Sine of $7''+17'''+51''''$, which is the Angle c w k, [by Trigonometry.]

3. The 20th Day of *November* aboveſaid being advanced beyond the autumnal Equinox towards the Winter Solſtice; therefore at the Time of Mr. *Flamſteed*'s Obſervation on the ſaid 20th Day of *November*, the Sun was ſomewhere under the Quadrant of the Ecliptick betwixt the Beginning of ♎ (*Libra*) and the Beginning of ♑ (*Capricorn*).

In the Figure for Sect. 5. Num. 3. let the Arch ♎ ♏ R ϖ repreſent the Quadrant of the Ecliptick betwixt the Beginning of *Libra* and the Beginning of *Capricorn*, and let the prick-lin'd Arch K u α repreſent a Quadrant of the Equinoctial Circle northward above the Quadrant of the Ecliptick ♎ ♏ R ϖ.

Let N be the North Pole of the Equinoctial, and let the Line N u R n repreſent an Arch of the Semimeridian of *Greenwich* cutting the Arch ♎ ♏ R ϖ in R, in the Point the Sun was under at the Moment of Mr. *Flamſteed*'s Obſervation.

So the Arch N u is a Quadrant cutting the Quadrant K u α at Right Angles in the Point u; ſo the Triangle R u K is a ſpherical Triangle, right-angled at u, and the Arch R u is perpendicular to the Baſis K u, and the Arch of the Ecliptick ♎ ♏ R is the Hypothenuſe of the Triangle R u K.

Let the two-lin'd Arch O n H l be an Arch of the Rational Horizon of *Greenwich*, cutting the Equinoctial in l, in the Arch α u K produced beyond K, and cutting the Semimeridian of *Greenwich* in n, ſouthward from u.

So the Arch of the Semimeridian $nR = 16^\circ + 43' + 04'' + 27''' + 16''''$, as repreſenting the Sun's true Height above the Rational Horizon of *Greenwich*, and the Arch $Ru = 21^\circ + 48' + 22'' + 32''' + 44''''$, as repreſenting the Sun's Declination ſouthward from the Equinoctial at the Time of Obſervation on the ſaid 20th Day of *November*.

So in the ſpherical Triangle RuK, having the Leg $Ru = 21^\circ + 48' + 22'' + 32''' + 44''''$, and having the Angle oppoſite that Leg $= 23^\circ + 28' + 54''$, [as in Chap. 3. Num. 13.] we have the Hypothenuſe ♎ ♏ $R = 68^\circ + 47' + 30'' + 33''' + 40''''$ [as in the Proof].

Then out of this Hypothenuſe ſubtracting 60° for the Signs ♎ and ♏, we have the Remainder $= 8^\circ + 47' + 30'' + 33''' + 40''''$ for the Arch of the Ecliptick ♐ R.

So the Sun, according to its apparent Motion, was under $8^\circ + 47' + 30'' + 33''' + 40''''$ of ♐ (*Sagittary*) at Noon at *Greenwich* on the 20th Day of *November* (*Old Style*) in the *Julian* Year of Chriſt 1711.

Sun's Place at Noon on *Nov.* 20, 1711.

PROOF

For Sect. 5. Num. 3.

The Angle $RKu = 23^\circ + 28' + 54''$, and the Sine of it = 39845,58; the Leg $Ru = 21^\circ + 48' + 22'' + 32''' + 44''''$, and the Sine = 37146,9255+. Then, As the Sine of RKu (39845,58) : Sine of Ru (37146,9255+) :: ſo Radius (100000): 93227,2174+, = Sine of $68^\circ + 47' + 30'' + 33''' + 40''''$, = Sine of the Hypothenuſe ♎ ♏ ♐ R, [by Caſe 10. of Right-angled ſpherical Triangles, *Caſwell*.]

OF THE MOTION OF THE *SUN.*

CHAP. V.

Of the Sun's *Right Aſcenſion, and Aſcenſional Difference; of the Equation of Time, and of the two Cauſes of the Inequality betwixt apparent and equal Time.*

SECT. I.

Firſt Section. 1. LET the 1ſt Figure for Chap. 5. Sect. 1. repreſent an Half-globe, the Circle ♈ N ♎ ⊓ paſſing through the North Pole of the Equator, N, and through the South Pole of the Equator, ⊓, and cutting the Equator and the Ecliptick in their common Interſections in the equinoctial Points ♈ and ♎.

And let the prick'd Line B A *α* *υ* K repreſent that Semicircle of the Equator intercepted betwixt ♈ and ♎, which is above the ſix ſouthern Signs of the Ecliptick.

And let the 2d Figure repreſent the other Half of the Globe, the prick'd Line K E α A B repreſent the other Semicircle of the Equator which is below the northern Signs of the Ecliptick.

And let the two curvilinear Lines ♈ ♉ ♊ ♋ ♌ ♍ ♎ ♏ ♐ ♑ ♒ ♓ ♈ repreſent the Ecliptick Circle, whoſe Plane is ſo ſituated as to correſpond with the Plane of the Ecliptick deſcrib'd upon the Celeſtial Globe.

Let T be the Centre of the Equator, and of the Ecliptick, where, alſo, the Centre of the Earth is placed, the ſtrait Line N T ⊓ being the Axis of the Equator, about which the diurnal Motions of the Sun, Moon, and Stars, are perform'd, the Heavens being continually mov'd by a very rapid Motion, from Eaſt to Weſt, all round this Axis, in about Twenty-three Hours and Fifty-ſix Minutes, and carrying along with them the Equator and the Ecliptick, and the Orbit of the Sun, and the ſtarry Sphere; whilſt, on the contrary, the Sun moves in the Circumference of his Orbit, from Weſt to Eaſt, ſo much as that the rapid Motion of the Heavens doth not bring him to the Semimeridian of the ſame Place of the Earth, this Day, from which he departed Yeſterday at Noon, till about Four Minutes after the ſame Point of the Heavens, which was upon that Semimeridian Yeſterday, hath made its Revolution to the ſame Semimeridian this Day.

Let the Plane, paſſing through the Points F, γ, B, and m, in the 1ſt Figure, be in the Plane of the Ecliptick, and be that Part of the Sun's elliptical Orbit which is under the ſouthern Signs of the Ecliptick, T being the lower Focus, and B being the *Perigæum* of that Orbit.

And let the Plane, paſſing through the Points G, n, A, δ, in the 2d Figure, be in the Plane of the Ecliptick, and be the remaining Part of the Sun's elliptical Orbit which is under the northern Signs of the Ecliptick, Φ, in the Part of the tranſverſe Axis T c Φ A, being the upper Focus, c being the Centre, and A being the *Apogæum* of that Orbit.

Let the Body of the Earth be ſuppos'd to remain without Motion.

Note. Here it is to be *noted*, That I explain the *Phænomena* of the Sun's Motions by ſuppoſing the Heavens to be mov'd, by a very rapid Motion, from Eaſt to Weſt, round the Axis of the Equator, in about 23 Hours + 56 Minutes, whilſt the Body of the Earth remains without Rotation, according to the *Ptolemaick* Syſtem, becauſe the Globes in common Uſe are accommodated hereto; ſo that thoſe Appearances are, to many, more intelligibly explain'd thereby.

But, at the ſame time, I affirm, that the vaſtly leſs rapid Motion of the Body of the Earth from Weſt to Eaſt, round the Axis of the Equator, in about 23 Hours + 56 Minutes, whilſt the Equinoctial and Ecliptick, with the Heavens, ſtand ſtill, will more reaſonably account for thoſe *Phænomena*.

For the better comprehending this Chapter, it will be convenient to place a Globe before you, rectified and ſituated as Occaſion requires.

2. In the Plane of the Ecliptick, in the 1ſt Figure, draw the Line T m P, cutting the Sun's elliptical Orbit in the Point m, and cutting the Ecliptick in the Point P, in $21^{\circ}+10'+56''$ of ♒, and let the Sun have been at the Point m of its Orbit at Noon at *Greenwich*, on the 30th aſtro-

nomical Day of *January* (*Old Style*) in the *Julian* Year of Chriſt 1711. [as in Chap. 4. Sect. 2. Num. 3.].

Upon the Superficies of this Globe let a Semimeridian be drawn, paſſing through the Point A of the Equinoctial, and the Point P of the Ecliptick, in the 1ſt Figure; then the Semicircle B *a* E K, in the 2d Figure, and the Arch K *a* A, in the 1ſt Figure, is call'd the Sun's Right Aſcenſion, at the ſaid Noon; and the Right Aſcenſion of the Point P of the Ecliptick, the Sun, at the Point m of its Orbit, having been under that Semimeridian (the Semimeridian of *Greenwich*) at the ſaid Noon, and the little Arch P A, cutting the Equinoctial Circle at Right Angles in the Point A [*Caſwell*'s Spherical Trigonometry, Num. 19.].

Sun's Right Aſcenſion.

And the Right Aſcenſions of the Points of the Ecliptick being meaſur'd by Arches of the Equinoctial reckon'd eaſtward from B (from ♈) to the Points of the Interſections of the Semimeridians paſſing through thoſe reſpective Points of the Ecliptick.

Let the Heavens, with the Equator and the Ecliptick, revolve, by an equable Motion weſtward, round the Axis N Π, under the Semimeridian of G, ſo as that at the End of 23 Hours + 56 Minutes forward from the ſaid Noon, the Point A of the Equinoctial, together with the Point P of the Ecliptick, ſhall be return'd to be under the Semimeridian of G again; in the mean time let the Sun move eaſtward from the Point m of its Orbit, ſo as that, at the End of about Four Minutes forward, the Sun, at the Point of its Orbit c, ſhall be return'd to be under the Semimeridian of G, and under the Point a of the Ecliptick, when it will be Noon again to the Inhabitants at G, and when an apparent Day

Apparent Day.

from the Noon next foregoing will be cómpleted, when alſo the Point b of the Equinoctial will be under the Semimeridian of G, together with the Sun at a, the little Arch a b cutting the Equinoctial Circle at Right Angles in the Point b.

So at Noon, on the 31ſt aſtronomical Day of *January (Old Style)* at *Greenwich* in the *Julian* Year of Chriſt 1711. the Sun's Right Aſcenſion, and the Right Aſcenſion of the Point a, of the Ecliptick, was the Semicircle B α E K, in the 2d Figure, + Arch K α A b, in the firſt Figure; and the little Arch A b of the Equinoctial is call'd the Aſcenſional Difference betwixt the Sun's Right Aſcenſions at the Beginning and at the End of that apparent Day; or the Aſcenſional Difference betwixt the Right Aſcenſion of the Point P, and of the Point a, of the Ecliptick.

Aſcenſional Difference.

So in the Space of 24 Hours from the firſt of theſe Noons, the whole Equinoctial Circle, and the whole Ecliptick Circle, together with the ſmall Arch of the Equinoctial A b, and the ſmall Arch of the Ecliptick P a, mov'd weſtward from the Semimeridian of G, to the ſame Semimeridian again, by the diurnal Motion.

And the Sun's Motion eaſtward, through the little Arch of its Orbit m c, together with the Motion of the Orbit eaſtward, (which is call'd the Motion of the *Apogæum*) in that Space of Time, is call'd the Sun's apparent Motion under the Arch P a, of the Ecliptick, in that Space of Time, *viz.* in that one apparent Day.

3. And as this is the Caſe with reſpect to One Day, ſo is the Caſe with reſpect to many Days, and aliquot Parts of a Day; ſo that, calling the little Arch of the Equinoctial A b $= \zeta$, and calling the little Arch of the Ecliptick P a $= \xi$, and calling an aliquot Part of a

Day $= \frac{1}{Z}$ of a Day, in $\varkappa$ Days $+ \frac{1}{Z}$ of a Day the Equinoctial and Ecliptick Circles will revolve weſtward under the Semimeridian of G, $\varkappa$ times $+ \frac{360^\circ}{Z}$.

And over and above $\varkappa C + \frac{C}{Z}$ of the Equinoctial, and $\varkappa \xi + \frac{\xi}{Z}$ of the Ecliptick will revolve weſtward under the Semimeridian of G.

And the Aſcenſional Difference in thoſe $\varkappa$ Days $+ \frac{1}{Z}$ of a Day, will be the Arch of the Equator intercepted betwixt the Sun's Right Aſcenſion at the Beginning of thoſe $\varkappa$ Days (betwixt the Point A of the Equinoctial, for Inſtance) and the Extremity of the Arch $\varkappa C + \frac{C}{Z}$ of the Equinoctial.

Aſcenſional Diff. in $\varkappa$ Days $+ \frac{1}{Z}$ of a Day.

And the Sun's apparent Motion under the Ecliptick in thoſe $\varkappa$ Days $+ \frac{1}{Z}$ of a Day, will be the Arch of the Ecliptick intercepted betwixt the Point P of the Ecliptick, ſor Inſtance, and the Extremity of the Arch $\varkappa \xi + \frac{\xi}{Z}$ of the Ecliptick.

Sun's apparent Motion under Eclipt. in $\varkappa$ Days $+ \frac{1}{Z}$ of a Day.

So putting 5 Hours + 48 Minutes + 57 Seconds (putting 75373200 Fourths) $= \frac{1}{Z}$ of a Day $= \frac{75373200}{311040000}$, we have $75373200\ Z =$ 311040000

311040000 Fourths; ſo $Z = \dfrac{311040000 \text{ Fourths.}}{75373200}$

$$\text{So } \frac{360^{\circ}}{Z}\left(\frac{4665600000^{\prime\prime\prime\prime}}{Z}\right) = \frac{4665600000}{1} \div \frac{31\ 040000}{75373200} = \frac{351661201920000000^{\prime\prime\prime}}{311040000}.$$

$$\text{And } \frac{\mathcal{C}}{Z} = \frac{75373200\,\mathcal{C}}{311040000}\text{; and } \frac{\xi}{Z} = \frac{75373200\,\xi}{311040000}.$$

So in the Space of 565 Days + 5 Hours + 48 Minutes + 57 Seconds,(in the Space of a Tropical Year)the Equinoctial and Ecliptick Circles mov'd weſtward from the Semimeridian of G = 365 Revolutions + $\dfrac{351661201920000000^{\prime\prime\prime}}{311040000}$ of 1 Revolution, and over and above, the Equinoctial mov'd $365\,\mathcal{C} + \dfrac{75373200\,\mathcal{C}}{311040000}$; alſo, over and above the Ecliptick mov'd $365\,\xi + \dfrac{75373200\,\xi}{311040000}$.

And at the Beginning of this Tropical Year the Sun having been under the Point P of the Ecliptick, whoſe Right Aſcenſion is the Point A of the Equinoctial, at the Extremity of the Semicircle B *a* E K, in the 2d Figure, + Arch K *a* A in the 1ſt Figure [as in Num. 2.]. At the End of this Tropical Year the Sun will be found to have made an intire Revolution under the Ecliptick, and to appear under the ſame Point P of the Ecliptick, whoſe Right Aſcenſion is at the ſame Point A, of the Equinoctial, which it was at in the Beginning of the Tropical Year.

Fo

For a Tropical Year may be concluded to be the Space of Time taken up betwixt the Sun's Appearance under any Point of the Ecliptick, and its next apparent Return to be under the ſame Point of the Ecliptick again [ſee Chap. 1. Sect. 2. Num. 2.]. Tropical Year.

So the Aſcenſional Difference betwixt the Sun's Right Aſcenſion at the Beginning, and the Sun's Right Aſcenſion at the End of the Tropical Year, was the whole Equinoctial Circle,

$$= 365\,\mathcal{C} + \frac{75373200\,\mathcal{C}}{311040000}, = 360^{\circ}, = 4665600000''''.$$

And the Sun's apparent Motion under the Ecliptick, in the Space of the Tropical Year, was the whole Ecliptick Circle,

$$= 365\,\xi + \frac{75373200\,\xi}{311040000}, = 360^{\circ}, = 4665600000''''.$$

Then multiplying by 311040000, we have $113529600000\,\mathcal{C} + 75373200\,\mathcal{C}\ (113604973200\,\mathcal{C}) = 145118822400000000$ Fourths; ſo

$$\mathcal{C} = \frac{145118822400000000''''}{113604973200}, = 1277398\frac{,00367764-}{,00367764-}5 \text{ Fourths}$$

$,00367764-, = 59' + 08'' + 19''' + 45''''$

$,00367764-.$

This is the middling Quantity of the Sun's Aſcenſional Difference for each Day throughout the Tropical Year.

And this is the middling Quantity of the Sun's Motion under the Ecliptick for each Day throughout the Year.

But there are conſiderable Inequalities betwixt the Quantities of the Sun's Aſcenſional Differences, and of the Sun's middle Motions under the Ecliptick for the ſame Numbers of Days at various Seaſons of the Year.

4. Let the Sun have been at the Point m of its Orbit, in the 1ſt Figure, under the Point P of the Ecliptick, in $21^{\circ}+10'+56'$ of ♒, at Noon, at *Greenwich*, on the 30th aſtronomical Day of *January* (*Old Style*) in the *Julian* Year of Chriſt 1711. as above [Num. 2.].

Leg A B. Then we have the Leg A B of the Equinoctial, in the 1ſt Figure, $= 1\,\text{S.}+06^{\circ}+25'+25''+52'''+19''''$, and ſo we have the Right Aſcenſion of the Sun at that Moment, **Sun's Right Aſcenſion.** $= 10\,\text{S.}+23^{\circ}+34'+34''+07'''+41''''$, = Right Aſcenſion of the Point P of the Ecliptick in the Line T m P [as in the 1ſt Proof].

Then let the Sun move eaſtward to the Point n of its Orbit, in the 2d Figure, under the Point P of the Ecliptick, in $15^{\circ}+58'+23''+33'''+27''''$ of ♊, at Noon at *Greenwich*, on the 27th aſtronomical Day of *May*, in the *Julian* Year of Chriſt 1711. [as in Chap. 4. Sect. 3. Num. 3.].

Leg B A. Then we have the Leg B A of the Equinoctial, in the 2d Figure, $= 2\,\text{S.}+14^{\circ}+45'+48''+01'''+47''''$, = Right Aſcenſion of the Sun at that Moment, = Right Aſcenſion of the Point P of the Ecliptick, in the Line T n P [as in the 2d Proof].

Then to the Leg A B, in the 1ſt Figure,

$$\begin{array}{rcrcrcrcrcrcr} & & \text{S.} & & {}^{\circ} & & {}' & & {}'' & & {}''' & & {}'''' \\ & = & 1 & + & 06 & + & 25 & + & 25 & + & 52 & + & 19 \\ \left.\begin{array}{r}\text{adding the Leg BA}\\ \text{in the 2d Fig.}\end{array}\right\} & = & 2 & + & 14 & + & 45 & + & 48 & + & 01 & + & 47 \\ \hline \text{we have the Sum} & = & 3 & + & 21 & + & 11 & + & 13 & + & 54 & + & 06 \end{array}$$

Aſcenſional Difference. which was the Aſcenſional Difference betwixt the Sun's Right Aſcenſions at thoſe two Noons reſpectively, being diſtant from each other the Space of 117 apparent Days.

Then the Sun's middle Motion in its Orbit in 117 Days of equal Time

$$
\begin{array}{lrrrrrr}
 & \text{S.} & {}^{\circ} & {}' & {}'' & {}''' & {}'''' \\
 & = 3 & +25 & +18 & +58 & +30 & +10 \\
\text{and the Motion of the } \textit{Apogæum} \;\} & = 0 & +00 & +00 & +16 & +00 & +36 \\
\hline
\text{ſo we have the Sum} & = 3 & +25 & +19 & +14 & +30 & +46
\end{array}
$$

being the Sun's middle Motion under the Ecliptick in 117 Days of equal Time:

This is more than the Aſcenſional Difference in thoſe 117 apparent Days, by $4^{\circ}+08'+00''+36'''+40''''$.

So taking ξ for the middling Quantity of the Sun's Motions under the Ecliptick on each Day throughout the Year, and taking ς for the little Arch of the Equinoctial paſſing under the Semimeridian of G, on each apparent Day, over and above the intire Revolution of the Equinoctial [Num. 3.] it appears, that the 117 ξ of the Ecliptick did exceed the 117 ς of the Equinoctial, by $4^{\circ}+08'+00''+36'''+40''''$: Therefore, after 117 Returns of the Sun to the Semimeridian of G, from the ſaid Noon on the ſaid 30th of *January*, the Equinoctial Circle muſt have roll'd weſtward under that Semimeridian, through an Arch $=4^{\circ}+08'+00''+36'''+40''''$, before 117 Days of equal Time were completed; and while that Arch was rolling thus, 16 Minutes + 29 Seconds + 19 Thirds + 56 Fourths of equal Time were taken up [as in the 3d Proof].

Equation of Time to be ſubtracted from the equal Time.

This Space of Time is call'd the Equation of Time, being to be ſubtracted from 117 Days of equal Time to give a Remainder = 116 Days + 23 Hours + 43 Minutes + 30 Seconds + 40 Thirds + 04 Fourths, which was the Quantity of equal Time contain'd in the 117 Days of apparent Time betwixt the two Noons on the ſaid

30th Day of *January*, and the ſaid 27th Day of *May*.

So that reckoning from the ſaid Noon on the ſaid 30th of *January* 117 Days of equal Time were not completed till 16 Minutes + 29 Seconds + 19 Thirds + 56 Fourths of equal Time after Noon on the ſaid 27th Day of *May*.

And if the Reaſon of this Inequality be inquir'd into, we ſhall find, that it is occaſion'd by two Cauſes:

First Cauſe. 1ſt, By the Shortneſs of the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 117 apparent Days, in compariſon of the Sun's middle Motion under the Ecliptick in 117 equal Days.

Second Cauſe. 2dly, By the Shortneſs of the Arch of the Aſcenſional Difference, in compariſon of the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 117 apparent Days.

1ſt, The Arch of the Sun's apparent Motion under the Ecliptick in thoſe 117 apparent Days, was the Sum of the two Hypothenuſes P ♓ ♈, in the 1ſt Figure, and ♈ ♉ ♊ P, in the 2d Figure;

where P♓♈ being = $\left.\right\} \overset{S}{1}+\overset{\circ}{08}+\overset{\prime}{49}+\overset{\prime\prime}{04}+\overset{\prime\prime\prime}{00}+\overset{\prime\prime\prime\prime}{00} \left\{\right.$ 1ſt Proof

and ♈♉♊P being = $\left.\right\} 2+15+58+23+33+27 \left\{\right.$ 2d Proof

we have the Sum = $\left.\right\} 3+24+47+27+33+27 =$ the Sun's apparent Motion under the Ecliptick in thoſe 117 apparent Days.

Subtracting this out of the Sun's middle Motion under the Ecliptick in 117 Days of equal Time (above), we have the Remainder $= 31'+46''+57'''+19''''$, = the Quantity by which the Arch of the Sun's apparent Motion under the

Ecliptick in thoſe 117 apparent Days, was ſhorter than the Arch of the Sun's middle Motion under the Ecliptick in 117 Days of equal Time. This I call the Defect in the 1ſt Inſtance.

Defect in the 1ſt Inſtance.

2dly, The Arch of the Sun's Aſcenſional Difference in thoſe 117 apparent Days, was the Sum of the two Legs A B in the 1ſt Figure, and B A in the 2d Figure, which is $= 3$ S. $+ 21^{\circ} + 11' + 13'' + 54''' + 06''''$, as above.

Subtracting this out of the Sun's apparent Motion under the Ecliptick in thoſe 117 apparent Days (above), we have the Remainder $= 3^{\circ} + 36' + 13'' + 39''' + 21''''$ for the Quantity by which the Aſcenſional Difference was ſhorter than the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 117 apparent Days.

This I call the Defect in the 2d Inſtance.

Defect in the 2d Inſtance.

So we have the Sum of theſe two Defects the ſame Quantity as the Defect by which the 117 C of the Equinoctial did come ſhort of the 117 ξ of the Ecliptick, *viz.* $= 4^{\circ} + 08' + 00'' + 36''' + 40''''$, as above.

Firſt PROOF

For Num. 4.

First Proof.

Angle P ♈ A, in the 1ſt Figure, = greateſt Declination of the Ecliptick, $= 23^{\circ} + 28' + 54''$ [Chap. 3. Num 13.] ſo the Complement $= 66^{\circ} + 31' + 06''$ = Angle ♈ P A in the right-angled Triangle ♈ A P, right-angled at A; and the Sine of this Complement = 91718,7622.

Then P cutting the Ecliptick in $21^{\circ} + 10' + 56''$ of ♒ [Num. 4.] we have the Hypothenuſe P ♓ ♈, in the 1ſt Figure, $= 38^{\circ} + 49' + 04''$, and the Tangent of it = 80453,166. Then ſay,

As Radius (100000) : Coſine of P ♈ A (91718,7622) :: ſo the Tangent of the Hypothenuſe (80453,166) : 73790,648+ = Tangent of 56° (1 S. + 06°) $+ 25'$

Leg ♈ A (A B).

$+25'+25''+52'''+19''''$, = Leg ♈ A [by 4th Caſe of right-angled ſpherical Triangles, *Caſwell*].

Then ſubtracting this out of 12 Signs, we have the Remainder = 10 S. $+23^\circ+34'+34''+07'''+41''''$, *viz.* = the Semicircle B α E K, in the 2d Figure, + Arch K α A, in the 1ſt Figure, which is the Right Aſcenſion of the Sun under $21^\circ+10'+56''$ of ♒ [Num. 2.].

Second PROOF

For Num. 4.

Second Proof.

Angle P ♈ A, in the 2d Figure, $=23^\circ+28'+54''$, and Coſine = 91718,7622 [as in the 1ſt Proof].

Then P cutting the Ecliptick in $15^\circ+58'+23''+33'''+27''''$ of ♊ at Noon at *Greenwich* on the 27th aſtronomical Day of *May* in the *Julian* Year of Chriſt 1711. [Num. 4] we have the Hypothenuſe ♈ ♉ ♊ P $=75^\circ+58'+23''+33'''+27''''$; and we have the Tangent of it = 400280,7372. Then ſay,

As Radius (100000) : Coſine of P ♈ A (91718,7622) :: ſo Tangent of the Hypothenuſe (400280,7372) : 367132,5375— = Tangent of $74^\circ+45'+48''+01'''+47''''$, = Leg ♈ A [by 4th Caſe, &c.] = Sun's Right Aſcenſion under $15^\circ+58'+23''+33'''+27''''$ of ♊ [Num. 2.].

Third PROOF

For Num. 4.

Third Proof.

In the Space of 24 Hours (in the Space of 311040000 Fourths) of equal Time, the whole Equinoctial Circle + the little Arch of it A b, in the 1ſt Figure, rolls equably weſtward under the Semimeridian of G, by the diurnal Motion [Num. 2.].

Now the whole Equinoctial Circle $=360^\circ=4665600000''''$, and the little Arch A b, which I call G, = $12773985''''.00367764$ — at the middling Quantity of it [Num. 3.] So in 24 Hours of equal Time there roll under the Semimeridian of G $4678373985''''$,0036774 of the Equinoctial by an equable Motion. Then ſay,

As $4678373985''''$,00367764 : 311040000 Fourths : : ſo 1° ($12960000''''$) : 861640 Fourths ,90620 3 Mn + 59 Sec. + 20 Th. + 41 Fourths —

So whilſt 1° of the Equinoctial paſſes under the Semimeridian of G, there are taken up 3 Minutes + 59 Seconds + 20 Thirds + 41 Fourths — of equal Time.

And whilſt 10° of the Equinoctial paſs under the Semimeridian of G, there are taken up 8616409 Fourths ,0620 = 39 Min. + 53 Sec. + 26 Th. + 49 Fou + of equal Time.

Thus proceeding orderly ſo far as to 60° incluſive, I put the ſeveral Reſults orderly in a Table, amongſt the Tables at the End, under the Title

A Table of the Equal Time taken up whilſt Arches of the Equinoctial Circle move under the Semimeridian of G, by the Diurnal Motion,

Table of equal Time taken up.

And theſe Reſults which denote Hours, Minutes, Seconds, Thirds, and Fourths, for Degrees; they denote Minutes, Seconds, Thirds, Fourths, and Fifths, for Prime Scruples: and they denote Seconds, Thirds, Fourths, Fifths, and Sixths, for Second Scruples; and ſo on.

And by that Table I find, that whilſt $4^\circ + 08' + 00'' + 36''' + 40''''$ of the Equinoctial paſs under the Semimeridian of G, 16 Min. + 29 Sec. + 19 Th. + 56 Fou. of equal Time are taken up.

5. Let the Sun move from the Point n of its Orbit, and be come to the Point ∂ of the Orbit, eaſtward from n, and under the Point Q of the Ecliptick, in $1^\circ + 47' + 29'' + 40''' + 14''''$ of ♌, in the 2d Figure, at Noon at *Greenwich* on *July* 14. (*Old Style*) in the *Julian* Year of Chriſt 1711. as above [Chap. 4 Sect. 4. Num. 3].

Right Aſcenſion of Point Q of the Eclиptick.

Then we have the Sun's Right Aſcenſion, the Quadrant B A α + Arch α E (in the 2d Figure) $= 124^\circ (4 \text{ Signs} + 4^\circ) + 02' + 57'' + 56''' + 22''''$ [as in the Proof] *viz.* the Right Aſcenſion of the Point Q of the Ecliptick in the Line T δ Q.

And the Sun's Right Aſcenſion at the ſaid Noon at *Greenwich*, on the ſaid 27th Day of *May* (the Leg B A of the Equinoctial in the 2d Figure) being $= 74^\circ (2 \text{ Signs} + 14^\circ) + 45' + 48 + 01''' + 47''''$ [as in Num. 4.] ſubtracting this Arch B A from the Arch B A α E, we have the Remainder $= 49^\circ (1 \text{ Sign} + 19^\circ) + 17' + 09'' + 54''' + 35''''$, which was the Sun's Aſcenſional Difference betwixt the Sun's Right Aſcenſions on the ſaid Noon on the ſaid 27th of *May*, and on the ſaid Noon on the ſaid 14th of *July*, being diſtant from each other the Space of 48 apparent Days in Time.

Aſcenſional Difference.

Sun's middle Motion under Ecliptick in 48 Days of equal Time.

Then the Sun's middle Motion in its Orbit in 48 Days of equal Time being

$$\begin{array}{lcccccc}
 & \text{S} & {}^\circ & ' & '' & ''' & '''' \\
= & 1 + & 17 + & 18 + & 33 + & 13 + & 55 \\
\text{and the Motion of the } \textit{Apogæum} \Big\} = & 0 + & 00 + & 00 + & 06 + & 34 + & 06 \\
\hline
\text{we have the Sum,} = & 1 + & 17 + & 18 + & 39 + & 48 + & 01
\end{array}$$

= the Sun's middle Motion under the Ecliptick in 48 Days of equal Time.

This is leſs than the Aſcenſional Difference in thoſe 48 apparent Days, by $1^\circ + 58' + 30'' + 06''' + 34''''$.

So taking ξ for the middling Quantity of the Sun's Motions under the Ecliptick on each Day throughout the Year, and taking ζ for the little Arch of the Equinoctial paſſing under the Semimeridian of G on each apparent Day, over and above the intire Revolutions of the Equinoctial [Num. 3.] it appears, that the 48 ξ of the Ecliptick did fall ſhort of thoſe 48 ₲ of the Equinoctial by $1^{\circ}+58'+30''+06'''+34''''$; therefore, after 48 Days of equal Time were completed from the ſaid Noon on the ſaid 27th Day of *May*, the Equinoctial Circle did roll weſtward under the Semimeridian of G through an Arch $= 1^{\circ}+58'+30'+06'''+34''''$ before 48 Returns of the Sun to that Semimeridian (before 48 apparent Days) were finiſh'd, and whilſt that Arch was rolling thus, 7 Minutes + 52 Seconds + 42 Thirds + 47 Fourths of equal Time were taken up; as is eaſy to prove, from my Table of equal Time taken up, *&c.* deſcrib'd above [in the 3d Proof for Num. 4.].

Equation of Time to be added to the equal Time.

This Space of Time is call'd the Equation of Time, being to be added to 48 Days of equal Time to give a Sum which was equal to the Time of 48 apparent Days betwixt the two ſaid Noons on the ſaid 27th of *May* and the ſaid 14th Day of *July*.

So that reckoning from the ſaid Noon on the ſaid 27th Day of *May*, 48 Days of equal Time were completed, 7 Minutes + 52 Seconds + 42 Thirds + 47 Fourths before Noon on the ſaid 14th of *July*; or were completed on the 13th aſtronomical Day of *July* (*Old Style*) at 23 Hours + 52 Minutes + 07 Seconds + 17 Thirds + 13 Fourths of equal Time in the ſaid Year 1711.

And if the Reaſon of this Inequality be inquir'd into, we ſhall find, that it is occaſion'd by two Cauſes:

Firſt Cauſe.

1ſt, By the Shortneſs of the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 48 apparent Days, in compariſon of the Sun's middle Motion under the Ecliptick in 48 equal Days.

Second Cauſe.

2dly, By the Length of the Arch of the Aſcenſional Difference, in compariſon of the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 48 apparent Days.

1ſt, The Arch of the Sun's apparent Motion under the Ecliptick in thoſe 48 apparent Days, was the Quadrant ♈ ♉ ♊ ♋ — Hypothenuſe ♈ ♉ ♊ P, + Quadrant ♋ ♌ ♍ ♎ — Hypothenuſe Q ♍ ♎ ♏, the Sum of the two Arches P ♋ and ♋ ♌ Q, in the 2d Figure, where the Hypothenuſe ♈ ♉ ♊ P being $= 2\,S. + 15^\circ + 58' + 23'' + 33''' + 27''''$ [2d Proof for Num. 4.] we have the Remainder P ♋ $= 0\,S. + 14^\circ + 01' + 36'' + 26''' + 33''''$.

And Q being in $1^\circ + 47' + 29'' + 40''' + 14''''$ of ♌, we have the Arch ♋ ♌ Q $= 1\,S. + 01^\circ + 47' + 29'' + 40''' + 14''''$; ſo the Sum of the two Arches P ♋ and ♋ ♌ Q $= 1\,S. + 15^\circ + 49' + 06'' + 06''' + 47''''$, = the Sun's apparent Motion under the Ecliptick in thoſe 48 apparent Days. Then out of the Sun's middle Motion under the Ecliptick in 48 Days of equal Time,

$$\overset{S.}{=1}+\overset{\circ}{17}+\overset{'}{18}+\overset{''}{39}+\overset{'''}{48}+\overset{''''}{01}\ \text{(as above)}$$

ſubtracting the Sun's apparent Motion under the Ecliptick in thoſe 48 apparent Days,

$$=1+15+49+06+06+47 \quad \text{we have}$$

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the Rem^r $=0+01+29+33+41+14$ = the Quantity by which the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 48 apparent Days, was ſhorter than the Arch of the Sun's middle Motion under the Ecliptick in 48 Days of equal Time.

Defect in the 1ſt Inſtance.

This I call the Defect in the 1ſt Inſtance.

2dly, The Arch of the Sun's Aſcenſional Difference in thoſe 48 apparent Days, was the Arch of the Equinoctial B A x E — Leg B A, in the 2d Figure,

= 1

$= 1^{S.} + 19^{\circ} + 17^{\prime} + 09^{\prime\prime} + 54^{\prime\prime\prime} + 35^{\prime\prime\prime\prime}$ (as above) out of this ſubtracting the Sun's apparent Motion under the Ecliptick in thoſe 48 apparent Days, $= 1 + 15 + 49 + 06 + 06 + 47$ we have

the Rem^{r} $= 0 + 03 + 28 + 03 + 47 + 48$ for the Quantity by which the Aſcenſional Difference was longer than the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 48 apparent Days.

This I call the Exceſs in the 2d Inſtance.

Excess in the 2d Inſtance.

Then out of the Exceſs in the 2d Inſtance, $= 3^{\circ} + 28^{\prime} + 03^{\prime\prime} + 47^{\prime\prime\prime} + 48^{\prime\prime\prime\prime}$ ſubtracting the Defect in the 1ſt Inſtance, $= 1 + 29 + 33 + 41 + 14$ we have

the Remainder $= 1 + 58 + 30 + 06 + 34$ for the Defect by which the 48 ξ of the Ecliptick did come ſhort of the 48 ζ of the Equinoctial in thoſe 48 apparent Days, being the ſame Quantity as above.

PROOF

For Num. 5.

Angle Q ♎ E, in the 2d Figure, $= 23^{\circ} + 28^{\prime} + 54^{\prime\prime}$, and Coſine = 91718,7622 [as in the 1ſt Proof for Num. 4].

Then Q cutting the Ecliptick in $1^{\circ} + 47^{\prime} + 29^{\prime\prime} + 40^{\prime\prime\prime} + 14^{\prime\prime\prime\prime}$ of ♌ at Noon at *Greenwich* on the 14th aſtronomical Day of *July* (*Old Style*) in the *Julian* Year of Chriſt 1711. [Num. 5] we have the Hypothenuſe Q ♍ ♎ $= 58^{\circ} + 12^{\prime} + 30^{\prime\prime} + 19^{\prime\prime\prime} + 46^{\prime\prime\prime\prime}$, and we have the Tangent of it = 161341,6494. Then ſay,

As Radius (100000) : Coſine of Q♎E (91718,7622) : : ſo Tangent of Hypothenuſe (161341,6494) : 147980,5637+ = Tangent of $55^{\circ} + 57^{\prime} + 02^{\prime\prime} + 03^{\prime\prime\prime}$

$+03'''+38''''$, = Leg E ♎ (EK) [by 4th Caſe of Right-angled ſpherical Triangles, *Caſwell*].

Then out of the Semicircle B α K

Leg E K.

$$=180^{\circ}+00'+00''+00'''+00''''$$

ſubtracting the Leg EK $= 55+57+02+03+38$

we have the Remainder $=124+02+57+56+22$ = Quadrant B A α + Arch α E, which is the Sun's Right Aſcenſion under the Point Q of the Ecliptick in $1^{\circ}+47+29''+40'''+14''$ of ♌ [Num. 2.]

6. Again, Let the Sun move from the Point δ of its Orbit, and be come to the Point γ of its Orbit, in the 1ſt Figure, eaſtward from δ, and under the Point R of the Ecliptick, in $8^{\circ}+47'+30''+33'''+40''''$ of ♐, at Noon at *Greenwich* on the 20th aſtronomical Day of *November* (*Old Style*) in the *Julian* Year of Chriſt 1711. as above [Chap. 4. Sect. 5. Num. 3.]

Right Aſcenſion of the Point R of the Ecliptick.

Then we have the Sun's Right Aſcenſion, the Semicircle B α K, in the 2d Figure, + Arch K U, in the 1ſt Figure, $= 8\text{ S.}+07^{\circ}+04'+13''+06'''+54''''$ [as in the Proof] *viz.* the Aſcenſion of the Point R of the Ecliptick in the Line T γ R.

And the Sun's Right Aſcenſion at the ſaid Noon at *Greenwich* on the ſaid 14th Day of *July* (the Arch B α E of the Equinoctial, in the 2d Figure) being $= 4\text{ S.}+4^{\circ}+02'+57''+56'''+22''''$ [as in Num. 5.]

Aſcenſional Difference.

Subtracting this Arch B α E from the Semicircle B α K + Arch K U, we have the Sum of the Legs E K and K U $= 4\text{ S.}+03^{\circ}+01'+15''+10'''+32''''$, which is the Aſcenſional Difference betwixt the Sun's Right Aſcenſions on the ſaid Noon on the ſaid 14th Day of *July*, and the ſaid Noon on the ſaid 20th Day of *November*, being diſtant from each other the Space of 129 apparent Days.

Then the Sun's middle Motion in its Orbit in 129 Days of equal Time being

$$= \overset{S.}{4} + \overset{\circ}{07} + \overset{\prime}{08} + \overset{\prime\prime}{36} + \overset{\prime\prime\prime}{48} + \overset{\prime\prime\prime\prime}{38}$$

and the Motion of the *Apogæum* was

$$= 0 + 00 + 00 + 17 + 39 + 07$$

ſo we have the Sum of theſe Motions

$$= 4 + 07 + 08 + 54 + 27 + 45$$

which was the Sun's middle Motion under the Ecliptick in 129 Days of equal Time.

Sun's middle Motion under the Ecliptick in 129 Days of equal Time.

This is more than the Aſcenſional Difference in thoſe 129 Days of apparent Time, by $4^{\circ}+07'+42''+22'''+41''''$.

So it appears that the 129 ξ of the Ecliptick did exceed the 129 ζ of the Equinoctial by $4^{\circ}+07'+39''+17'''+13''''$; therefore after 129 Returns of the Sun to the Semimeridian of G, from the ſaid Noon on the ſaid 14th Day of *July*, the Equinoctial Circle muſt have roll'd weſtward under that Semimeridian, through an Arch = $4^{\circ}+07'+39''+17'''+13''''$ before 129 Days of equal Time were completed; and, whilſt that Arch was rolling thus, 16 Minutes + 27 Seconds + 54 Thirds + 52 Fourths— of equal Time were taken up; as is eaſy to prove from my Table of equal Time taken up, *&c.* which is deſcrib'd above [in the 3d Proof for Num. 4.].

This Space of Time is call'd the Equation of Time, being to be ſubtracted from 129 Days of equal Time to give a Remainder = 128 Days + 23 Hours + 43 Minutes + 32 Seconds + 05 Thirds + 08 Fourths+, which was the Quantity of equal Time contain'd in the 129 Days of apparent Time betwixt the two ſaid Noons on the

Equation of Time to be ſubtracted from the equal Time.

the ſaid 14th of *July*, and the ſaid 20th of *November*.

So that reckoning from the ſaid Noon on the ſaid 14th of *July*, 129 apparent Days forward, were completed 16 Minutes + 27 Seconds + 54 Thirds + 52 Fourths − before 129 Days of equal Time were completed, or thoſe 129 Days of apparent Time were finiſh'd on the 19th aſtronomical Day of *November* (*Old Style*) at 23 Hours + 43 Minutes + 32 Seconds + 05 Thirds + 08 Fourths + of equal Time, in the *Julian* Year of Chriſt 1711.

As to the Reaſon of this Inequality, it is occaſion'd,

1ſt Cauſe. 1ſt, By the Shortneſs of the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 129 apparent Days, in compariſon of the Sun's middle Motion under the Ecliptick in 129 equal Days.

2d Cauſe. 2dly, By the Shortneſs of the Arch of the Aſcenſional Difference in compariſon of the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 129 apparent Days.

1ſt, The Arch of the Sun's apparent Motion under the Ecliptick in thoſe 129 apparent Days, was the Sum of the two Hypothenuſes Q♍♎ in the 2d Figure, and ♎♏♐R in the 1ſt Figure.

Where the Hypothenuſe Q♍♎ being

$=\overset{S.}{1}+\overset{\circ}{28}+\overset{\prime}{12}+\overset{\prime\prime}{30}+\overset{\prime\prime\prime}{19}+\overset{\prime\prime\prime\prime}{46}$ [Proof for Num. 5.] and R being in $8^{\circ}+47^{\prime}+30^{\prime\prime}+33^{\prime\prime\prime}+40^{\prime\prime\prime\prime}$ of ♐ above, we have the Hypothenuſe ♎♏♐R $=2+08+47+30+33+40$; ſo the Sum = $\overline{\text{Sun's apparent Motion under the Ecliptick in thoſe 129 apparent Days,}}$

Sun's apparent Motion under the Ecliptick in thoſe 129 apparent Days,

$=4+07+00+00+53+26$.

Then out of the Sun's middle Motion under the Ecliptick in 129 Days of equal Time,

$= 4^{S.} + 07^{\circ} + 08' + 54'' + 27''' + 45''''$ (as above)

ſubtracting the apparent Motion under the Ecliptick in 129 apparent Days,

$= 4 + 07 + 00 + 00 + 53 + 26$ we have

---

the Rem^r $= 0 + 00 + 08 + 53 + 34 + 19$ = the Quantity by which the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 129 apparent Days was ſhorter than the Arch of the Sun's middle Motion under the Ecliptick in 129 Days of equal Time.

This I call the Defect in the 1ſt Inſtance.

Defect in the 1ſt Inſtance.

2dly, The Arch of the Sun's Aſcenſional Difference in thoſe 129 apparent Days was the Sum of the Legs E K and K ♈ of the Equinoctial, $= 4S. + 03^{\circ} + 01' + 15'' + 10''' + 32''''$; ſubtracting this out of the Sun's apparent Motion under the Ecliptick in thoſe 129 apparent Days (above),

we have the Remainder $= 3^{\circ} + 58' + 45'' + 42''' + 54''''$

I call this the Defect in the 2d Inſtance.

Defect in the 2d Inſtance.

Add $0 + 08 + 53 + 34 + 19$

=Defect in the 1ſt Inſtance ——————

we have $4 + 07 + 39 + 17 + 13$

= the Sum of the two Defects, = the Quantity by which the 129 ζ of the Equinoctial did come ſhort of the 129 ξ of the Ecliptick in the 129 apparent Days, as above.

P R O O F

For Num. 6.

The Angle R ♎ ♈, in the 1ſt Figure, $= 23^{\circ} + 28' + 54''$, and Coſine = 91718,7622 [as in Proof for Num 4.].

Then R cutting the Ecliptick in $8^{\circ}+47'+30''+33'''+40''''$ of ♐, at Noon at *Greenwich* on the 20th aſtronomical Day of *November* (*Old Style*) in the *Julian* Year of Chriſt 1711. [Num. 6.] we have the Hypothenuſe ♎ ♏ ♐ R $= 68^{\circ} + 47' + 30'' + 33''' + 40''''$; and we have the Tangent of it = 257724,97882. Then ſay,

As Radius (100000) : Coſine of R ♎ υ (91718,7622) : : ſo Tangent of Hypothenuſe (257724,97882) : 236391,33233+ = Tangent of $67^{\circ}+04'+13''+06'''+54''''$ = Leg ♎ υ [by Caſe 4. of Right-angled Triangles, *Caſwell*].

Leg ♎ υ.

Then to the Semicircle of the Equinoctial B α E K adding the Leg ♎ υ (K υ) we have the Sum = 8 S. $+07^{\circ}+04'+13''+06'''+54''''$ = the Sun's Right Aſcenſion under the Point R of the Ecliptick in $8^{\circ} + 47' + 30'' + 33''' + 40''''$ of ♐ [Num. 2.].

(K υ).

7. Again, Let the Sun be come to the Point of its Orbit cutting the Line T P, in the 1ſt Figure, under the Point P of the Ecliptick, in $21^{\circ}+10'+56''$ of ♒ on the 30th aſtronomical Day of *January* (*Old Style*) at 5 Hours + 48 Minutes + 57 Seconds of apparent Time at *Greenwich*, in the *Julian* Year of Chriſt 1712. This was the End of the Tropical Year from Noon at *Greenwich* on the ſaid 30th of *January* in the ſaid Year of Chriſt 1711. [as in Num. 3.].

Sun's Right Aſcenſion at the End of the Tropical Year.

Then the Sun's Right Aſcenſion was the Semicircle B A α K (6 Signs) + Arch K υ α A = 4 Signs $+ 23^{\circ} + 34' + 34'' + 07''' + 41''''$ [Num 4. 1ſt Proof], which was the Sun's Right Aſcenſion at the End of this Tropical Year alſo [Num. 3.].

Aſcenſional Difference.

And the Sun's Right Aſcenſion at Noon at *Greenwich* on the ſaid 20th of *November* next foregoing, being the Semicircle B α K = 6 Signs + Arch K υ = 2 S. $+ 07^{\circ} + 04' + 13'' + 06''' + 54''''$ [Proof for Num. 6.].

Subtracting the Arch $K\upsilon$ from the Arch $K\upsilon\alpha A$, we have the Arch $\upsilon\alpha A = 2\,\text{S.} + 16^\circ + 30' + 21'' + 00''' + 47''''$, which was the Aſcenſional Difference betwixt the Sun's Right Aſcenſions at Noon at *Greenwich* on the ſaid 20th of *November* and the ſaid 30th of *January* at 5 Hours + 48 Minutes + 57 Seconds, being diſtant from each other the Space of 71 apparent Days + 5 Hours + 48 Minutes + 57 Seconds in Time.

Aſcenſional Difference.

Then the Sun's middle Motion in its Orbit in 71 Days + 5 Hours + 48 Minutes + 57 Seconds of equal Time being

$$= \overset{\text{S.}}{2} + \overset{\circ}{10} + \overset{\prime}{13} + \overset{\prime\prime}{01} + \overset{\prime\prime\prime}{28} + \overset{\prime\prime\prime\prime}{33} + \overset{\prime\prime\prime\prime\prime}{01} + \overset{\prime\prime\prime\prime\prime\prime}{24}$$

and the Motion of the *Apogæum* being

$$= 0 + 00 + 00 + 09 + 44 + 55 + 45 + 30$$

we have the Sum of theſe two Motions

$$= 2 + 10 + 13 + 11 + 13 + 29$$

= Sun's middle Motion under the Ecliptick in that Space of equal Time, $= 71\,\xi + \frac{\xi}{Z}$ of the Ecliptick in that Space of equal Time.

Then out of the Sun's Aſcenſional Difference, out of $71\,\text{ϛ} + \frac{\text{ϛ}}{Z}$ of the Equinoctial,

$$= \overset{\text{S.}}{2} + \overset{\circ}{16} + \overset{\prime}{30} + \overset{\prime\prime}{21} + \overset{\prime\prime\prime}{00} + \overset{\prime\prime\prime\prime}{47}$$

ſubtracting $71\,\xi + \frac{\xi}{Z} = 2 + 10 + 13 + 11 + 13 + 29$

we have the Rem^{r} $= 0 + 06 + 17 + 09 + 47 + 18$ which was the Quantity by which the Aſcenſional Difference in thoſe 71 apparent Days, + 5 Ho. + 48 Min. + 57 Sec. did exceed the middle

Motion under the Eckliptick in the like Space of equal Time.

Therefore after 71 Days + 5 Hours + 48 Minutes + 57 Seconds of equal Time, from the ſaid Noon on the ſaid 20th of *November*, were completed, the Equinoctial did roll weſtward under the Semi-meridian of G, through an Arch $= 6^{\circ}+17'+09''+47'''+18''''$, before the Point A of the Equinoctial, with the Point P of the Ecliptick (in the 1ſt Figure) was return'd to the Semimeridian of G; and whilſt that Arch was rolling thus, 25 Minutes + 04 Seconds + 31 Thirds + 59 Fourths + of equal Time were taken up, as is eaſy to prove from my Table of equal Time taken up, whilſt Arches of the Equinoctial, *&c.* deſcrib'd above [in the 3d Proof for Num. 4.].

Equation of Time to be added to the equal Time.

This is the Equation of Time, to be added to 71 Days + 5 Hours + 48 Minutes + 57 Seconds of equal Time, to give a Sum which was equal to the Space of apparent Time betwixt Noon at *Greenwich* on the ſaid 20th Day of *November* in the ſaid Year 1711. and the 30th aſtronomical Day of *January* (*Old Style*) at 5 Hours + 48 Minutes + 57 Seconds, in the *Julian* Year of Chriſt 1712.

So that reckoning from the ſaid Noon on the ſaid 20th Day of *November* 71 Days + 5 Hours + 48 Minutes + 57 Seconds of equal Time were completed, 25 Minutes + 04 Seconds + 31 Thirds + 59 Fourths before the 30th aſtronomical Day of *January*, at 5 Hours + 48 Minutes + 57 Seconds of apparent Time (*Old Style*) in the *Julian* Year of *Chriſt* 1712. was come; or that Space of equal Time was completed on the 29th aſtronomical Day of *January* (*Old Style*) at 23 Hours + 34 Minutes + 55

Seconds + 28 Thirds + 01 Fourth of equal Time, in the *Julian* Year of Chriſt 1712.

And if the Reaſon of this Inequality be inquir'd into, we ſhall find, that it is occaſion'd by two Cauſes:

1ſt Cauſe.

1ſt, By the Length of the Arch of the Sun's apparent Motion under the Ecliptick in 71 apparent Days + 5 Hours + 48 Minutes + 57 Seconds, from the ſaid Noon on the ſaid 20th of *November*, in compariſon of the Sun's middle Motion under the Ecliptick in 71 Days + 5 Hours + 48 Minutes + 57 Seconds of equal Time.

2d Cauſe.

2dly, By the Length of the Arch of the Aſcenſional Difference in compariſon of the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 71 apparent Days + 5 Hours + 48 Minutes + 57 Seconds.

1ſt, The Arch of the Sun's apparent Motion under the Ecliptick in thoſe 71 apparent Days + 5 Hours + 48 Minutes + 57 Seconds, was the Quadrant ♎ ♏ ♐ R ♑ — Hypothenuſe ♎ ♏ ♐ R (Arch R ♑) + Hypothenuſe ♑ ♒ P, in the 1ſt Figure.

Where the Hypothenuſe ♎ ♏ ♐ R being
S. ° ′ ″ ‴ ⁗
=2+08+47+30+33+40 [from Num. 6.]
ſubtracting this from the Quadrant ♎ ♏ ♐ R ♑, we have the Remainder = the Arch R ♑,
=0+21+12+29+26+20
and the Hypothenuſe ♑ ♒ P being
=1+21+10+56+00+00 [from Num. 4.]
we have the Sum of theſe two,

=2+12+23+25+26+20 = the Sun's apparent Motion under the Ecliptick in thoſe 71 apparent Days + 5 Hours + 48 Minutes + 57 Seconds; then out of this ſubtracting the Sun's middle Motion under the Ecliptick in 71 Days + 5 Ho. + 48 Min. + 57 Sec. of equal Time,

$$\underline{\overset{S.}{=2}+\overset{\circ}{10}+\overset{\prime}{13}+\overset{\prime\prime}{11}+\overset{\prime\prime\prime}{13}+\overset{\prime\prime\prime\prime}{29}} \text{ (above) the Rem}^{r}$$

=0+02+10+14+12+51 = the Quantity by which the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 71 apparent Days + 5 Hours + 48 Minutes + 57 Seconds, was longer than the Arch of the Sun's middle Motion under the Ecliptick in 71 Days + 5 Hours + 48 Minutes + 57 Seconds of equal Time.

Exceſs in the 1ſt Inſtance.

This I call the Exceſs in the 1ſt Inſtance.

2dly, The Arch of the Sun's Aſcenſional Difference in thoſe 71 apparent Days + 5 Hours + 48 Minutes + 57 Seconds,

$$\overset{S.}{=2}+\overset{\circ}{16}+\overset{\prime}{30}+\overset{\prime\prime}{21}+\overset{\prime\prime\prime}{00}+\overset{\prime\prime\prime\prime}{47} \text{ (above)}$$

out of this ſubtracting the Sun's apparent Motion under the Ecliptick in thoſe 71 apparent Days + 5 Hours + 48 Minutes + 57 Seconds,

$$\underline{=2+12+23+25+26+20} \text{ (above)}$$

we have the Remainder =0+04+06+55+34+27 for the Quantity by which the Aſcenſional Difference was longer than the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 71 apparent Days + 5 Hours + 48 Minutes + 57 Seconds.

Exceſs in the 2d Inſtance.

This I call the Exceſs in the 2d Inſtance.

Then we have the Sum of the two Exceſſes, $= 6^{\circ}+17'+09''+47'''+18''''$ = the Quantity by which the Sun's middle Motion under the Ecliptick in 71 Days + 5 Hours + 48 Minutes + 57 Seconds of equal Time, did come ſhort of the Aſcenſional Difference in thoſe 71 apparent Days + 5 Hours + 48 Minutes + 57 Seconds, being the ſame Quantity by which the Aſcenſional Difference in that Space of apparent Time did exceed the middle Motion under the Ecliptick in the like Space of equal Time, as above.

8. Here it may be obſerv'd, that the Quantity by which the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 48 apparent Days betwixt the ſaid Noon on the ſaid 27th of *May* and the ſaid Noon on the ſaid 14th Day of *July*, was ſhorter than the Arch of the Sun's middle Motion under the Ecliptick in 48 Days of equal Time, by $1^{\circ}+29'+33''+41'''+14''''$; and that the 48 Days of equal Time contain'd a leſs Space of Time than thoſe 48 Days of apparent Time [Num. 5. Equation of Time to be added. Defect in the 1ſt Inſtance].

Where the *Apogæum* of the Sun's Orbit found.

So becauſe the Sun's apparent Motion under the Ecliptick in the ſmall Space of 48 apparent Days, was ſo ſlow in compariſon of the middle Motion under the Ecliptick, I ſhall conclude, that the *Apogæum* of the Sun's Orbit lay in that Part of the Orbit which the Sun paſs'd through betwixt the ſaid two Noons.

And it may be obſerv'd, that the Quantity by which the Arch of the Sun's apparent Motion under the Ecliptick in thoſe 71 apparent Days + 5 Hours + 48 Minutes + 57 Seconds, betwixt the ſaid Noon on the ſaid 20th of *November* and the ſaid 30th of *January* in 1712. at 5 Hours + 48 Minutes + 57 Seconds, was longer than the Arch of the Sun's middle Motion under the Ecliptick in the like Space of equal Time, by $2^{\circ}+10'+14''+12'''+51''''$; and that the Sun's middle Motion under the Ecliptick during the Equation of Time to be added, bears very ſmall Proportion to that Difference betwixt the ſaid Arches [Num. 7. Equation of Time to be added. Exceſs in the 1ſt Inſtance]. So becauſe the Sun's apparent Motion under the Ecliptick in thoſe 71 apparent Days + 5 Hours + 48 Minutes + 57

Seconds, was ſo ſwift as to exceed the middle Motion by ſo great an Exceſs, I ſhall conclude, that the *Perigæum* of the Sun's Orbit lay in that Part of the Orbit which the Sun paſs'd through betwixt the ſaid Noon on the ſaid 20th of *November*, and the ſaid 30th of *January* in 1712. at 5 Hours + 48 Minutes + 57 Seconds [ſee Chap. 1. Sect. 7. Numbers 1, 2, 3.].

9. At Noon at *Greenwich*, on the 30th aſtronomical Day of *January* (*Old Style*) in the *Julian* Year of Chriſt 1711. let the Sun have been at the Point m of its Orbit[a], under the Point P of the Ecliptick, in $21^\circ + 10' + 56''$ of ♒[b]; and at the ſame Moment let the Body have been at the Point h of the Circle.

Then the Angle h T u (k T m)[a] is the Equation of the Orbit, to be added to the mean Anomaly, 6 Signs + Angle I T h, to give the true Anomaly 6 Signs + Angle B T m [Chap. 4. Sect. 1. Num. 7.].

In the Space of 117 apparent Days forwards, namely, at Noon at *Greenwich*, on the 27th aſtronomical Day of *May* (*Old Style*) in the ſaid Year 1711. let the Sun be mov'd eaſtward to the Point n of its Orbit[a], under the Point P of the Ecliptick, in $15^\circ + 58' + 23'' + 33''' + 27''''$ of ♊[c], and at the ſame Moment let the Body have been at the Point o of the Circle[a]; then the Angle o T σ (β T n)[a] is the Equation of the Sun's Orbit, to be added to the mean Anomaly 6 Signs + Angle I T o, to give the true Anomaly 6 Signs + Angle B T n [*Ibid.* Num. 7.].

Theſe 117 apparent Days were no more than 116 Days + 23 Hours + 43 Minutes + 30 Seconds + 40 Thirds + 04 Fourths of equal Time [Chap. 5. Num. 4. Equation of Time] during which Space of Time the Sun's middle Motion

[a] In Fig. 1. for Ch. 4. Sect. 1. Num. 3.

[b] In Fig. 1. for Ch. 5. Sect. 1.

[c] In Fig. 2 for Ch. 5. Sect. 1.

in its Orbit was $= 3\,S. + 25^{\circ} + 18' + 17'' + 52''' + 26''''$ = Angle h T o [a]; and the Motion of the *Apogæum* was $16'' + 00''' + 30''''$; which being ſubtracted from the Sun's apparent Motion under the Ecliptick in thoſe 117 apparent Days, $= 3\,S. + 24^{\circ} + 47' + 27'' + 33''' + 27''''$ [Num. 4. 1ſt Cauſe] we have the Remainder $= 3\,S. + 24^{\circ} + 47' + 11'' + 32''' + 57''''$ for the Sun's apparent Motion in its Orbit, *viz.* for the Angle m T n [a], in the Interval of Time of thoſe 117 apparent Days.

Angle h T o.

Angle m T n.

Then ſubtracting this Angle m T n from the Angle h T o, we have the Remainder $= 0\,S. + 00^{\circ} + 31' + 06'' + 19''' + 29''''$ = Angle h T o — Angle m T n.

And this Remainder = Equation h T u — Equation o T σ likewiſe.

For Angle h T o = Equation h T u (Angle k T m) + Angle U T o (+ Angle m T n); and Angle m T n = Equation o T σ (Angle β T n) + Angle m T β (+ Angle U T o):

Therefore ſubtracting, we have
Angle h T o — Angle m T n = Equation h T u — Equation o T σ;
So Equation h T u — Equation o T σ $= 31' + 06'' + 19''' + 29''''$.

10. In the Space of 48 apparent Days forwards from Noon at *Greenwich* on the 27th aſtronomical Day of *May* (*Old Style*), namely, at Noon at *Greenwich* on the 14th aſtronomical Day of *July* (*Old Style*) in the *Julian* Year of Chriſt 1711. let the Sun be mov'd eaſtward to the Point δ of its Orbit [a], under the Point Q of the Ecliptick, in $1^{\circ} + 47' + 29'' + 40''' + 14''''$ of ♌ [b]; and at the ſame Moment let the Body have been at the Point ν of the Circle [a].

Then the Line T δ cutting the Circle in the Point ♈ [a], we have the Angle ♈ T ν the Equation of the Orbit to be ſubtracted from the mean Anomaly E T ʳ, to leave the Remainder E T γ (A T δ) which is the true Anomaly [Chap. 4. Sect. 1. Num. 5.].

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[a] In Fig. 1. for Ch. 4. Sect. 1. Num. 3.

[b] In Fig. 2. for Ch. 5. Sect. 1.

Theſe 48 apparent Days were equal to 48 Days + 7 Minutes + 52 Seconds + 42 Thirds + 47 Fourths of equal Time [Num. 5. Equation of Time]; during which Space of Time the Sun's middle Motion in its Orbit was = 1 S. + 17° +
Angle o T ν. 18′ + 52″ + 38‴ + 42⁗ — = Angle O T ν [a].

And the Motion of the *Apogæum* was 6″ + 34‴ + 09⁗, which being ſubtracted from the Sun's apparent Motion under the Ecliptick in thoſe 48 apparent Days, = 1 S. + 15° + 49′ + 06″ + 06‴ + 47⁗ [Num. 5. 1ſt Cauſe], we have the Remainder = 1 S. + 15° + 48′ + 59″ + 32‴ + 38⁗ for the Sun's apparent Motion in its Orbit in the Interval of thoſe 48 apparent Days, *viz.* for the
Angle n T δ. Angle NTδ [a].

		S	°	′	″	‴	⁗
Then from the Angle oTν	=	1 +	17 +	18 +	52 +	38 +	42
ſubtracting the Angle NTδ	=	1 +	15 +	48 +	59 +	32 +	38
we have the Remʳ	=	0 +	01 +	29 +	53 +	06 +	04

for the Sum of the Equations of the Orbit o T σ and r T ʳ, of which the Equation o T σ is to be added to the mean Anomaly 6 Signs + Angle I T o, to give the true Anomaly 6 Signs + Angle B T n [a] [Chap. 4. Sect. 1. Num. 7.].

11. In the Space of 129 apparent Days forwards from Noon at *Greenwich* on the 14th aſtronomical Day of *July* (*Old Style*), namely, at Noon on the 20th Day of *November* (*Old Style*) in the *Julian* Year of Chriſt 1711. let the Sun be mov'd eaſtward to the Point γ of its Orbit [a], under the Point R of the Ecliptick, in 8° + 47′ + 30″ + 33‴ + 40⁗ of ♐ [b] [Num. 6.] and at the ſame Time let

[a] In Fig. 1. for Ch. 4. Sect. 1. Num. 3.

[b] In Fig. 1. for Ch 5. Sect. 1.

let the Body have been at the Point g of the Circle.

Then the Line T γ produced cutting the Circle in the Point s[a], we have the Angle s T g, the Equation of the Sun's Orbit, to be ſubtracted from the mean Anomaly E T g, to leave the Remainder E T s (A T γ) which is the true Anomaly [Chap. 4. Sect. 1. Num. 5.] Theſe 129 apparent Days were no more than 128 Days + 23 Hours + 43 Minutes + 32 Seconds + 05 Thirds + 08 Fourths of equal Time [Num. 6. Equation of Time to be ſubtracted]; during which Space of equal Time the Sun's middle Motion in its Orbit was = 4 S. $+07^{\circ}+07'+56''+14''+24''''$ = Angle ν T g, and the Motion of the *Apogæum* was = $17''+39''+01''''$, which being ſubtracted from the Sun's apparent Motion under the Ecliptick in thoſe 129 apparent Days, *viz.* from 4 S. $+07^{\circ}+00'+00''+53''+26'''$ [Num. 6. 1ſt Cauſe], we have the Remainder = 4 S. $+06^{\circ}+59'+43''+14'''+25''''$ = the Sun's apparent Motion in its Orbit in the Interval of thoſe 129 apparent Days, = the Angle δ T γ[a].

Angle ν T g.

Angle δ T γ.

Then ſubtracting this from the Sun's middle Motion in its Orbit in the Interval of equal Time, = 0 S. $+00^{\circ}+08'+12''+59'''=59''''$ = Angle ν T g, we have the Remainder = Angle ν T g — Angle δ T γ.

And this Remainder = Equation S T g — Equation r T ν.

For Angle ν T g = Angle ν T s + Equation s T g.

And Angle δ T γ = Angle γ T s + Equation r T ν.

Then ſubtracting, we have Angle ν T g — Angle δ T γ = Equation s T g — Equation ϒ T ν.

So the Equation s T g — Equation r T ν $= 8'+12''+59'''+59''''$.

12. In the Space of 71 apparent Days + 6 Hours + 9 Minutes + 14 Seconds forwards from Noon at *Greenwich* on the ſaid 20th of *November*, namely, on the 30th aſtronomical Day of *January* (*Old Style*) at 6 Hours + 9 Minutes + 14 Seconds, in the *Julian* Year of Chriſt 1712. let the Sun be mov'd eaſtward, and return'd to the Point m of its Orbit [a], under the Point of the Ecliptick q, ſomewhat eaſtward of the Point P [b], having completed its Revolution round its Orbit at the End of a Sidereal Year from Noon at *Greenwich* on the ſaid 30th of *January* in the *Julian* Year of Chriſt 1711. [Chap. 1. Sect. 6. Num. 7, 9.] and at the ſame Moment let the Body be return'd to the Point h of the Circle [a].

Now 71 apparent Days + 5 Hours + 48 Minutes + 57 Seconds of this apparent Time were equal to 71 Days + 06 Hours + 14 Minutes + 01 Second + 31 Thirds + 59 Fourths of equal Time [from Num. 7. Equation of Time to be added]; and the End of this equal Time completed a Tropical Year from Noon at *Greenwich* on the ſaid 30th of *January* in 1711.

But a Sidereal Year being longer than a Tropical Year by 20 Minutes + 17 Seconds, [Chap. 1. Sect. 6. Num. 9.] by adding 20 Minutes + 17 Seconds of equal Time to the End of the Tropical Year, we have the Space of Time betwixt Noon on the ſaid 20th of *November* and the End of the Sidereal Year on the ſaid 30th of *January* in the *Julian* Year of Chriſt 1712. = 71 Days + 6 Hours + 34 Minutes + 18 Seconds + 31 Thirds + 59 Fourths of equal Time; during which Space of Time the Sun's middle

[a] In Fig. 1. for Ch. 4. Sect. 1. Num. 3.

[a] In Fig. 1. for Ch. 5. Sect. 1.

middle Motion in its Orbit $= 2\ S. + 10^{\circ} + 14' + 53'' + 14''' + 28''''$ = Angle g T h[a].

Angle g T h.

Then the Sun's apparent Motion under the Ecliptick in thoſe 71 apparent Days + 5 Hours + 48 Minutes + 57 Seconds, completing the Tropical Year, being $= 2\ S. + 12^{\circ} + 23' + 25'' + 26''' + 20''''$, [Num. 7. 1ſt Cauſe] and the Sun's middle Motion under the Ecliptick in 20 Minutes + 17 Seconds $= 49'' + 58''' + 50''''$, we have the Sum of theſe two $= 2\ S. + 12^{\circ} + 24' + 15'' + 25''' + 10''''$, for the Sun's apparent Motion under the Ecliptick in thoſe 71 Days + 6 Hours + 34 Minutes + 18 Seconds + 31 Thirds + 59 Fourths of equal Time.

And the Motion of the *Apogæum* in this Interval of equal Time $= 9'' + 45''' + 10''''$; which being ſubtracted from the Sun's apparent Motion under the Ecliptick in the Interval of equal Time, we have the Remainder $= 2\ S. + 12^{\circ} + 24' + 05'' + 40''' + 00''''$ for the Sun's apparent Motion in its Orbit in that Interval of equal Time, completing the ſaid Sidereal Year, = Angle γ T m[a].

Angle γ T m.

Out of this ſubtracting the Sun's middle Motion in its Orbit in that Interval of equal Time, (ſubtracting the Angle g T h, $= 2\ S. + 10^{\circ} + 14' + 53'' + 14''' + 28''''$, we have the Remainder $= 0\ S. + 02^{\circ} + 09' + 12'' + 25''' + 32''''$, = the Angle γ T m — the Angle g T h.

And this Remainder = the Sum of the Equations of the Orbit s T g and h T u, of which the Equation s T g is to be ſubtracted from the mean Anomaly E T g to leave the Remainder A T γ, which is the true Anomaly; and the Equation h T u is to be added to the mean Anomaly, 6 Signs + Angle I T h, to give the Sum 6 Signs + Angle B T m, which is the true Anomaly [Chap. 4. Sect. 1. Numbers 5, and 7.].

13. Leſt

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[a] In Fig. 1. for Ch. 4. Sect. 1. Num. 3.

Definition of Aſcenſional Difference radical Moment.

13. Leſt Miſtakes ſhould ariſe in determining the Aſcenſional Differences, of which I ſhall make great uſe in my Calculations for finding the Places of the Sun's Motions under the Ecliptick at given Moments of Time, I here define my Aſcenſional Difference to be, an Arch of the Equinoctial Circle intercepted betwixt the Right Aſcenſion of the Sun at the Moment at which the Account began, which I call my radical Moment, and the Sun's Right Aſcenſion at the End of the given Interval of Time from thence, at which the Sun's Place is requir'd to be aſſign'd; this intercepted Arch being to be meaſur'd from Weſt to Eaſt, according to the Order of the Signs, when the given Interval of Time is to be reckon'd forward from the radical Moment; but when the given Interval of Time is to be reckon'd backward from the radical Moment, then the intercepted Arch muſt be meaſur'd from Eaſt to Weſt, contrary to the Order of the Signs. For Explanation-ſake,

1ſt Inſtance.

Let the Sun be at the Point Q of the Ecliptick, in the 2d Figure, at ſome Moment of Time, the Sun's Right Aſcenſion at that Moment being the Point E, or the Arch B α E of the Equinoctial Circle.

At the End of the given Interval of Time let the Sun be at the Point N of the Ecliptick, and let the Sun's Right Aſcenſion then be the Point M, or the Semicircle B α E K + Arch K α M of the Equinoctial Circle.

1ſt Caſe.

Caſe 1. Let the given Interval of Time be reckon'd forward from the radical Moment when the Sun was at Q; then the intercepted Arch, which is the Aſcenſional Difference, is the Arch E M, proceeding according to the Order of the Signs, from E, in Fig. 2. through K and α to M, in Fig. 1.

Or, generally, when the Sun's Right Aſcenſion, at the radical Moment, is leſs diſtant from the vernal Equinox, according to the Order of the Signs, than it will be, or was, at the End of the Interval of equal Time forward, as in this 1ſt Caſe: Then,

Subtracting the Sun's Right Aſcenſion, at the radical Moment, from the Sun's Right Aſcenſion at the End of the Interval of equal Time forward, we have the Remainder for the Aſcenſional Difference in this 1ſt Caſe.

2d Caſe.

Caſe 2. But if the given Interval of equal Time be reckon'd backward from the radical Moment, when the Sun was at Q, then the intercepted Arch, which is the Aſcenſional Difference, is the Sum of the Arch E α B, in Fig. 2. and of the Arch B M, in Fig. 1. proceeding contrary to the Order of the Signs from E, thro' α and B, in Fig. 2. and ſo on to M, in Fig. 1.

Or, generally, when the Sun's Right Aſcenſion, at the radical Moment, is leſs diſtant from the vernal Equinox, according to the Order of the Signs, than it will be, or was, at the End of the Interval given of equal Time backward, as in this 2d Caſe:

Then, ſubtracting the Sun's Right Aſcenſion at the End of the Interval of equal Time backward, from 12 Signs, add the Remainder to the Sun's Right Aſcenſion at the radical Moment, we have the Sum for the Aſcenſional Difference, in this 2d Caſe.

2d Inſtance.

2d Inſtance. Let the Sun be at the Point N of the Ecliptick, in Fig. 1. at ſome radical Moment of Time; and at the End of ſome Interval of equal Time from thence let the Sun be come to the Point Q of the Ecliptick, in Fig. 2. the Sun's Right Aſcenſions at thoſe Moments of

Time being the Points M and E of the Equinoctial Circle reſpectively.

1ſt Caſe. Caſe 1. Let the given Interval of Time be reckon'd forward from the radical Moment when the Sun was at N; then the intercepted Arch, which is the Aſcenſional Difference, is the Sum of the Arch MB, in Fig. 1. and of the Arch B *α* E, in Fig. 2. proceeding according to the Order of the Signs, from M, in Fig. 1. through B and *α* to E, in Fig. 2.

Or, generally, when the Sun's Right Aſcenſion at the radical Moment is more diſtant from the vernal Equinox, according to the Order of the Signs, than it will be, or was, at the End of the given Interval of equal Time forward, as in this 1ſt Caſe: Then,

Subtracting the Sun's Right Aſcenſion at the End of the Interval of equal Time forward, from 12 Signs, add the Remainder to the Sun's Right Aſcenſion at the End of the Interval of equal Time forward; we have the Sum for the Aſcenſional Difference, in this 1ſt Caſe.

2d Caſe. Caſe 2. But if the given Interval of Time be reckon'd backward from the radical Moment when the Sun was at N; then the intercepted Arch, which is the Aſcenſional Difference, is the Arch M *α* K, in Fig. 1. + Arch K E, in Fig. 2. proceeding contrary to the Order of the Signs from M thro' *α* and K, in Fig. 1. to E in Fig. 2.

Or, generally, when the Sun's Right Aſcenſion at the radical Moment is more diſtant from the vernal Equinox, according to the Order of the Signs, than it will be, or was, at the End of the given Interval of equal Time backward: Then,

Subtracting the Sun's Right Aſcenſion at the End of the Interval of equal Time backward, from the Sun's Right Aſcenſion at the radical

Moment, we have the Remainder for the Aſcenſional Difference in this 2d Caſe.

14. Becauſe in calculating for finding the Places of the Sun's *Apogæum*, and of the Sun's middle and apparent Motions under the Ecliptick at the Ends of the given Intervals of Time, to be reckon'd from certain given Moments of apparent Time, from which the Account proceeds, which I call my radical Moments; there will be Occaſion to compare the Arches of the Sun's middle Motions under the Ecliptick, over and above the entire Revolutions, with the Arches of their correſponding Aſcenſional Differences during thoſe given Intervals of Time: Therefore, for the ſake of expeditiouſly going on in my Calculations in the enſuing Treatiſe, I ſhall call thoſe Arches of the Sun's middle Motions under the Ecliptick above the entire Revolutions, $= \xi m + \frac{\xi}{z}$, and I ſhall call thoſe Arches of the Aſcenſional Differences, $= \varsigma m + \frac{\varsigma}{z}$, where ξ ſtands for the Arch of the Ecliptick under which the Sun paſſes by its middle Motion in 1 Day of equal Time; and m ſtands for the Number of the Days contain'd in the given Interval of equal Time; and $\frac{\xi}{z}$ ſtands for ſuch aliquot Part or Parts of 1 equal Day, as are join'd to the whole Days. Radical Moments. ξ. m. $\frac{\xi}{z}$.

But ς ſtands for the Arch of the Equinoctial intercepted betwixt the Sun's Right Aſcenſions at the Beginning and the End of 1 apparent Day, or of 1 Day of apparent Time. And m, join'd to ς, ſtands for the Number of apparent Days in the given Interval of apparent Time; and ς. m.

$\frac{\zeta}{z}$. $\frac{\zeta}{z}$ ſtands for ſuch aliquot Part or Parts of 1 apparent Day as are join'd to the whole Days.

Theſe general Denominations I ſhall always uſe, whether there be any aliquot Part or Parts of 1 Day join'd to the whole Days or not; ſo that when no aliquot Part of 1 Day is join'd to the whole Days, then z is a Cypher.

And when the Quantity of equal Time deno-

$\zeta m + \frac{\zeta}{z}$. minated by $\xi m + \frac{\xi}{z}$ of the Ecliptick comes ſhort of the Quantity of apparent Time contain'd in the Interval of apparent Time denominated by

$\xi m\ \frac{\xi}{z}$. $\zeta m + \frac{\zeta}{z}$ of the Equinoctial, I call the Exceſs of the apparent Time the equal Time taken up whilſt the Arch $\zeta m + \frac{\zeta}{z} - \xi m - \frac{\xi}{z}$ of the Equinoctial was rolling weſtward under the Semi-meridian of G.

On the other hand, when the Quantity of ap-

$m + \frac{\xi}{z}$. parent Time denominated by $\zeta m + \frac{\zeta}{z}$ of the Equinoctial comes ſhort of the equal Time con-

$-\zeta m$. tain'd in the Interval denominated by $\xi m + \frac{\xi}{z}$ of the Ecliptick, I call the Exceſs of the equal Time, the equal Time taken up whilſt the Arch

$-\frac{\zeta}{z}$. $\xi m + \frac{\xi}{z} - \zeta m - \frac{\zeta}{z}$ of the Equinoctial was rolling weſtward under the Semi-meridian of G.

SECT.

SECT. II.

Lemma 1.] IN the firſt Figure for Chap. 5. Sect. 2. let the Line of Apſes B T c A cut the Arch of the Sun's elliptical Orbit n δ in the Point of the *Apogæum* A, ſo as to make the Angle A T δ = Angle n T A.

See the Figures below, at the End of this 5th Chapter.

Then the Equation of the Orbit r T ν = Equation of the Orbit o T τ. For

Becauſe Angle A T δ = Angle n T A, therefore the elliptical Area A T δ = elliptical Area n T A; and therefore the elliptical Area δ T B = elliptical Area B T n. Then, becauſe the Body moves round the Circumference of the Circle E a l b by an equable Motion, ſo as to form Sectors of that Circle equal to the elliptical Areas form'd from the lower Focus T by the Motion of the Sun in the Circumference of the Ellipſe in all Intervals of Time [Chap. 4. Sect. 1. Num. 3.]. Therefore when the Sun, in its Deſcent from the *Apogæum* A, ſhould be come to the Point δ of its Orbit, the Body, by its equable Motion from the Point E, would be come to the Point ν of the Circle, making the Sector E T ν = the Area A T δ; and when the Sun, in proceeding in its annual Courſe, ſhould be come to the Point n of its Orbit, the Body, by its equable Motion, would be come to the Point o of the Circle, making the Semicircle E a I + Sector I T o = the Semi-ellipſe A δ F B + Area B T n. And becauſe the Circle = the Ellipſe [Proof for Ch. 1. S. 7. N. 10.] therefore Sector I T o = Area B T n = Area δ T B = Sector ν T I; conſequently the Sector o T E = Sector E T ν: And becauſe the Angle A T δ = Angle n T A, therefore Sector r T ν =

Sector

Sector o T σ, that is to ſay, the Equation r T ν = Equation o T σ.

By the like way of reaſoning, if the Line of Apſes cuts the Arch of the Sun's elliptical Orbit γ m in the Point of the *Perigæum* B, ſo as to make the Angle γ T B = Angle B T m; then the Equation of the Orbit s T g = Equation of the Orbit h T u.

Lemma 2.] The Circumference of any Circle in Length (of A ξ B κ in the 2d and 3d Figures): is to the Radius of that Circle in Length (to c ξ, or C N, &c. in Length) :: As 710 : to 113 nearly [from the Prop. of *Metius* in *Wallis* his *Algebra*, Chap. 11. p. 52.]. Then ſay, As 710 : 113 :: ſo 360° (ſo 4665600000''''): 742553239'''',43+, therefore the Radius of a Circle in 4th Scruples = 742553239'''',43+.

See the 1ſt and 2d Figures for 3d *Lemma*.

Lemma 3.] In the 1ſt Figure for *Lemma* 3. in the Triangle C N D, right-angled at N, let the Leg C N be = C N, the Radius of the Circle y Q N, in the 2d Figure; and let the other Leg of the Triangle, the Leg N D, be equal to the Perimeter of that Circle.

This right angled Triangle is equal to that Circle [by Prop. 1. of *Archimedes*'s *De Circuli Dimenſione*].

COROLLARY.

Hence the Sector N C Q in the 2d Figure, is equal to a right-angled Triangle C N Q, in the 1ſt Figure, whoſe one Leg C N = Radius of the Circle C N, and whoſe other Leg N Q = Arch N Q bounding that Sector. For

Take the Point Q in the Leg N D, in the 1ſt Figure, and draw the ſtrait Line C Q; let the

Sector NCQ, in the 2d Figure, = Triangle CNQ, in the 1ſt Figure.

Then the remaining Sector of that Circle = the remaining Triangle CQD.

Call the Leg NQ, in the 1ſt Figure, $= x$; then $QD = ND - x$.

Call the Arch bounding the Sector which is equal to the Triangle $CNQ = y$; then the Arch bounding the Sector which is equal to the Triangle CQD (the Arch QZN) $= ND - y$.

So Sector NCQ : Sector QCN :: y : Arch QZN $(ND - y)$ :: Triangle CNQ : Triangle CQD :: $x : ND - x :: y : ND - y$. So $NDy - xy = NDx - xy$, therefore $NDy = NDx$; therefore $y = x$: Therefore the leſſer Arch NQ, in the 2d Figure, = the Leg NQ in the 1ſt Figure. Conſequently the Sector NCQ, in the 2d Figure, is equal to the right-angled Triangle CNQ in the 1ſt Figure, whoſe one Leg CN = Radius of that Circle CN, and whoſe other Leg NQ = Arch NQ bounding that Sector.

Lemma 4.] In the 2d and 3d Figures for Chap. 5. Sect. 2. half the conjugate Axis CF, being drawn at right Angles to the tranſverſe Axis AB, in the Centre C, and the Lines TF and φF being drawn from the two Foci T and φ, and cutting the Arch of the Ellipſe in the Point F, we have the Sum of the Lines TF and φF = the tranſverſe Axis AB [from Prop. 52. 3d Book of *Apollonius* his *Conicks*]; and becauſe $CT = C\varphi$, we have the Line TF = Line $\varphi F = CA = C\xi$. Alſo, we have $TF\,\square - CT\,\square = CF\,\square$ [from Prop. 47. of 1ſt Element].

Lemma 5.] In the 2d and 3d Figures for Chap. 5. Sect. 2. $C\xi\,\square : \theta Q\,\square :: Bc \times cA : B\theta \times \theta A$

[Prop. 13. and 17. of 6th Element: And $cF\square : \theta\rho\square :: Bc \times cA : B\theta \times \theta A$ [Prop. 21. of the 1ſt Book of *Apollonius* his *Conicks*]; ſo we have $c\xi\square : \theta Q\square :: cF\square : \theta\rho\square$. Therefore $c\xi : cF :: \theta Q : \theta\rho$ [Prop. 22. of the 6th Element].

Lemma 6.] $C\xi : cF :: \theta Q : \theta\rho$, in the 2d and 3d Figures for Chap. 5. Sect. 2. [by *Lemma* 5.]. Therefore all the Indiviſibles of the eccentrical Segment $A\theta Q$: are to all the Indiviſibles of the elliptical Segment $A\theta\rho$ :: As θQ : to $\theta\rho$; that is to ſay, the eccentrical Segment $A\theta Q$: is to the elliptical Segment $A\theta\rho$ :: As θQ : to $\theta\rho$.

Then the Triangle θQT : is to the Triangle $\theta\rho T$ :: As θQ : to $\theta\rho$ [Prop. 1. of the 6th Element]; therefore the Segment $A\theta Q +$ Triangle θQT (the Portion of the Eccentrick ATQ) : is to the Segment $A\theta\rho +$ Triangle $\theta\rho T$ (is to the elliptical Portion $AT\rho$) :: As θQ : to $\theta\rho$.

Then becauſe [by the Suppoſition in Chap. 4. Sect. 1. N. 8.] the Sector $AcN =$ the elliptical Portion ATQ, therefore the Sector AcN : is to the elliptical Portion $AT\rho$ :: As θQ : to $\theta\rho$.

And becauſe by the Conſtruction [Chap. 4. Sect. 1. Num. 4.] Angle AcN, in the 2d and 3d Figures, $=$ Angle $ET\nu$ and Angle ETg in the 1ſt Figure reſpectively; becauſe, alſo, the Circle $EaIb$, and the Ellipſe $AFBG$, in the 1ſt Figure, are equal to each other, [Chap. 4. Sect. 1. Num. 3.] therefore the Sector AcN, in the 2d and 3d Figures, is to its reſpective Sector $ET\nu$ and ETg in the 1ſt Figure :: As the whole eccentrick Circle $A\xi Bx$: is to the whole Circle $EaIb$ :: As the whole eccentrick Circle : is to the Ellipſe $AFBG$, the Ellipſes in the 1ſt, 2d, and 3d Figures being equal to each other, and of the ſame Species; therefore the Sector AcN, in the 2d and 3d Figures : is to its reſpective Sector

$ET\nu$ and ETg in the 1ſt Figure :: As θQ : to $\theta\rho$. Becauſe the whole Eccentrick $A\xi Bx$: to the whole Ellipſe $AFBG$ :: As the Segment $A\theta Q$: to the Segment $A\theta\rho$ :: As θQ : to $\theta\rho$. But the Sector AcN : is to its reſpective elliptical Portion $AT\rho$, in the 2d and 3d Figures :: As θQ : $\theta\rho$ likewiſe (as above); therefore the Portion $AT\rho$, in the 2d Figure, = Sector $ET\nu$, and therefore the Portion $AT\rho$, in the 3d Figure, = Sector ETg. And becauſe the Sectors $ET\nu$ and ETg are equal to the elliptical Areas $AT\delta$ and $AT\gamma$ reſpectively, in the 1ſt Figure; and becauſe, likewiſe, the Ellipſes in the 1ſt, 2d, and 3d Figures, are of the ſame Species, and equal to each other, [from Chap. 4. Sect. 1. Num. 3.] therefore the Angles $AT\rho$, in the 2d and 3d Figures, are reſpectively equal to the Angles $AT\delta$, $AT\gamma$, in the 1ſt Figure; and therefore the mean Anomaly $ET\nu$, in the 1ſt Figure, — the Angle $AT\rho$, in the 2d Figure (— true Anomaly $AT\delta$) = Equation of the Orbit $rT\nu$ in the 1ſt Figure. And therefore the mean Anomaly ETg, in the 1ſt Figure, — Angle $AT\rho$ in the third Figure (— true Anomaly $AT\gamma$) = Equation of the Orbit sTg in the 1ſt Figure.

And becauſe Angles ATk, in the 2d and 3d Figures, are reſpectively equal to the Angles $ET\nu$ and ETg, in the 1ſt Figure, [Chap. 4. Sect. 1. Num. 8.] therefore the Angle ATk — Angle $AT\rho$, (Angle $kT\rho$) in the 2d Figure, = Equation of the Orbit $rT\nu$ in the 1ſt Figure: And therefore Angle ATk — Angle $AT\rho$ (Angle $kT\rho$) in 3d Figure, = Equation of the Orbit sTg, in 1ſt Figure.

SECT.

SECT. III.

FROM the Slowneſs of the Sun's apparent Motion under the Ecliptick in the 48 apparent Days betwixt Noon at *Greenwich* on the 27th Day of *May (Old Style)* in the *Julian* Year of Chriſt 1711. and Noon at *Greenwich* on the 14th Day of *July* (*Old Style*) next following, it was concluded above, [Sect. 1. Num. 8.] that the *Apogæum* of the Sun's Orbit lay in that Arch of the Orbit which the Sun paſs'd through betwixt the ſaid two Noons.

In conſequence of which Concluſion, I ſhall inquire,

1ſt, Whether the Line of Apſes cuts the elliptical Arch $n\,\delta$ (in 1ſt Figure) in the Middle of that elliptical Arch. If ſo,

1. Then Angle nTA = Angle $AT\delta$; and then the Equation of the Orbit $oT\sigma$ = Equation of the Orbit $rT\nu$ [Sect. 2. *Lemma* 1.] ſo Angle $oT\nu$ being $= 47^\circ + 18' + 52'' + 38'' + 42''''$ [Sect. 1. Num. 10.] we have Angle $OTE \frac{(OT\nu)}{2} = 23^\circ + 39' + 26'' + 19''' + 21''''$ = mean Anomaly $ET\nu$.

Then Angle $nT\delta$ being $= 45^\circ + 48' + 59'' + 32''' + 38''''$ [Sect. 1. Num. 10.] we have Angle $nTA \frac{(nT\delta)}{2} = 22^\circ + 54' + 29'' + 46''' + 19''''$, = true Anomaly $AT\delta$. So Angle OTE — Angle nTA = Equation $oT\sigma = 44' + 56'' + 33''' + 02''''$, = Equation $rT\nu$ = Equation correſponding to the mean Anomaly $23^\circ + 39' + 26'' + 19''' + 21''''$.

2. Now the mean Anomaly E T ν being $= 23^{\circ}+39'+26'+19'''+21''''$, and the Equation of the Orbit correſponding being $= 44'+56'+32'''+02''''$ = Equation r T ν [Num. 1.] and the Semi axis C A being aſſum'd = 1927500000, we muſt find the Eccentricity C T of ſuch a Length, as that upon duly calculating, the Equation of the Orbit correſponding to the mean Anomaly $23^{\circ}+39'+26''+19'''+21''''$, may ariſe $= 44'+56''+33'''+02''''$, before we can proceed in our firſt Inquiry.

For though it was thought [Chap. 4. Sect. 1. Num. 9.] that As the Semi-axis (C A) : to the Eccentricity (C T) : : ſo 1927500000 : to 37500000; yet, upon calculating, I find C T muſt be leſs than 37500000, as will appear by the Reſults of the ſeveral Poſitions following.

[See the Appendix to Chap. 1. Sect. 6. Num. 5. below, in Sect. 6.]

In 2d Figure, from the Centre C draw C N, cutting the Eccentrick in N, ſo as to make the Angle A c N = the given mean Anomaly E T ν.

1ſt Poſition. Let the Eccentricity C T be equal to 3180000. 1ſt Poſition.

Let the Sector E T ν be in the upper Quadrant of the Semicircle E a I.

1. Produce N c, in 2d Figure, and draw T ε, cutting N C, produced, at right Angles, in the Point ε; the Angle T C ε is given, being equal to $23^{\circ}+39'+26''+19'''+21''''$, = Angle AcN, = Angle E T ν [Num. 2. Preamble] = Arch A N. Arch A N.

And the Sine of the Angle T C ε is equal to 40126,5472—. Then ſay, As the whole Sine (100000) : C T (3180000) : : ſo is the Sine of the Angle T c ε (40126,5472—) : 12760242 = T ε in Length.

T ξ⁗. And T ξ in 4th Scruples = 4915776⁗,4+ = 22′+45″+29‴+36⁗,4 [as in the Proof].

PROOF

For Num. 1.

Radius C A = 1927500000 = Radius C N. Then ſay, As Radius C N in Length (1927500000): T ξ in Length (12760242) : : ſo Radius C N in 4th Scruples (742553239⁗,43+) [Sect. 2. *Lemma* 2.] : to 4915776⁗,4114 = T ξ⁗.

2. In 2d Figure draw c δ cutting the Arch A N ξ in δ, betwixt N and A, ſo as to make the
N δ. little Arch N δ = T ξ⁗ = 22′ + 45″ + 29‴ +
A δ. 36⁗,4+. Then we have Arch A δ (Arch AN — Arch N δ) = 23°+16′+40″+49‴+44⁗,6 = Angle A c δ.

And we have the Sine of this Angle A c δ = 39519,2993+.

Produce δ c, and draw T γ, cutting δ c, produced, at right Angles in the Point γ. The Angle T c γ is given, being = Angle A c δ; and the Sine of it = 39519,2993+. Then ſay, As the whole Sine (100000) : C T (31800000) : : ſo the Sine of Angle T c γ (39519,2993+): 12567137,18— = T γ in Length. And T γ in 4th Scruples = 4841384⁗,396+ = 22′+24″
T γ⁗. +49‴+44⁗,396 = T γ⁗ [as in the Proof].

PROOF

For Num. 2.

As Radius C N in Length (1927500000) : T γ in Length (12567137⁗,18—) : : ſo Radius C N⁗ (742553239⁗,43+) : 4841384⁗,369 = T γ⁗.

3. Out of the Arch A N, in the 2d Figure,

$= \overset{\circ}{23} + \overset{\prime}{39} + \overset{\prime\prime}{26} + \overset{\prime\prime\prime}{19} + \overset{\prime\prime\prime\prime}{21}$ [Num. 1.]

take the Arch N μ equal to T γ''''

Arch N μ.

$= 00 + 22 + 24 + 49 + 44,37 -$ [Num. 2.]

we have the Remainder equal to the Arch μ A

Arch A μ.

$= 23 + 17 + 01 + 29 + 36,63$

Then, becauſe by the Suppoſition [Chap. 4. Sect. 1. Num. 8.] the Portion of the Eccentrick A T Q (Sector A c Q + Triangle T c Q) = Sector A c N = Sector A c Q + Sector Q c N; therefore the Triangle T c Q = Sector Q c N. And becauſe the Angle C T Q is below the Centre C, therefore the Point Q muſt be found betwixt the Points N and A, in the Arch A ♌ N. Conſequently Angle A c Q $<$ Angle A c N; and Angle A c N being = Angle T c ε [N. 1.] therefore Angle A c Q $<$ Angle T c ε.

4. Draw Q c, and draw T ♉ cutting Q c, produced, at right Angles in the Point ♉; ſo = Angle T c ♉ = Angle A c Q; and Angle A c Q being $<$ Angle T c ε [Num. 3.] we have Angle T c ♉ $<$ Angle T c ε.

Angle T c ♉ = Angle A c Q.

So becauſe the Angle T c ε is acute, we have T ♉ $<$ T ε; conſequently T ♉'''' $<$ T ε''''; and T ε'''' being = Arch N ♌ [Num. 2.] therefore T ♉'''' $<$ Arch N ♌.

Then becauſe T ♉ cuts Q c, produced, at right Angles in ♉, therefore we have T ♉ the Altitude of the Triangle T c Q upon the Baſis (upon the Radius) Q c [by 4th Defin. of 6th Element].

And the Triangle T c Q being = Sector Q C N [Num. 3.] and the Sector Q C N being = a Triangle right-angled at N, whoſe Leg C N is the Radius of that Circle, = Radius Q c, and whoſe other Leg, or Altitude, = Arch NQ [Sect. 2. Corollary from 3d *Lemma*].

And T ♑ being the Altitude of the Triangle T c Q upon the Baſis (the Radius) Q c, conſequently T ♑ in 4th Scruples (conſequently T ♑'''') = Arch N Q.

T ♑'''' = Arch NQ.

And becauſe T ♑'''' < Arch N δ, therefore Arch N Q < Arch N δ; and therefore Angle A c Q < Angle A c δ.

5. Becauſe Angle T c ♑ = Angle A c Q, and becauſe Angle A c Q > Angle A c δ [Num. 4.] becauſe alſo Angle T c γ = Angle A c μ [Num. 2.] therefore Angle T c ♑ > Angle T c γ. And becauſe Angle T c ♑ is acute, therefore T ♑ > T γ, therefore T ♑'''' > T γ'''', and T ♑'''' and T γ'''' being = Arches NQ and N μ reſpectively [Numbers 3. and 4.] conſequently Arch N Q > Arch N μ.

And Arch NQ being alſo < Arch N δ [Num. 4.] therefore we find the Point Q betwixt the Points μ and δ, in the Arch of the Eccentrick A N ζ.

$$\left.\begin{array}{l}\text{So having}\\ \text{Arch A}\mu\end{array}\right\}=\overset{\circ}{23}+\overset{\prime}{17}+\overset{\prime\prime}{01}+\overset{\prime\prime\prime}{29}+\overset{\prime\prime\prime\prime}{36,63}\,[\text{N}.3.]$$

$$\left.\begin{array}{l}\text{and having}\\ \text{Arch A}\delta\end{array}\right\}=23+16+40+49+44,6\ [\text{N}.2.]$$

we have the ————————————

Difference $\mu\delta=00+00+20+39+52$.

Then to the Arch A δ adding the half Difference, $=10''+19'''+56''''$, we have the Sum $=23^{\circ}+16'+51''+09'''+40'''',6$; which I ſhall take to be = Angle A c Q nearly; and the Sine of it = 39523,8923 = Sine of Angle θ c Q. Then ſay,

As the Sine of the Angle Q θ c (100000) : Q c (1927500000) : : ſo the Sine of the Angle θ c Q

(39523,

(39523,8923) : 761823024,0825 + Qθ [by the 7th Caſe of right-angled plain Triangles, *Caſwell.*]

6. Let the Line CA = 1927500000, the Line CT = 31800000 [Num. 1.]; let half the conjugate Axis CF (in 2d Fig.) be drawn at right Angles to the tranſverſe Axis AB in the Centre C.

The Line TF = cA = cξ, and TF$\square$ − CT$\square$ = CF$\square$ [Sect. 2. *Lemma* 4.]

So we have TF$\square$ = 3715256250000000000
and we have CT$\square$ = 1011240000000000

ſo TF$\square$ − CT$\square$ (CF$\square$ = 3714245010000000000
and $\sqrt{}^2$ of this = CF = 1927237663,097 +, = half of the conjugate Axis of the Sun's elliptical Orbit. Then ſay, As Cξ (1927500000) : CF (1927237663,097 +) :: ſo Qθ (761823024,0825) : 761719338,3223 + = $p\theta$ [by Sect. 2. *Lemma* 5.].

7. The Angle AcQ being = 23°+16′+51″+09‴+40⁗,6 = Angle θcQ [Num. 5.] we have the Complement = 66°+43′+08″+50‴+19⁗,4 = Angle θQc; and we have the Sine of Angle θQc = 91857,8335—. Then ſay,

As Radius (100000) : Sine of θQc (91857,8335—) :: ſo QC (1927500000) : 1770559740,7125 = cθ [by 7th Caſe of right-angled plain Triangles, *Caſwell.*]

So cT being = 31800000 [Num. 1.] we have TC + cθ (Tθ) = 1802359740,7125.

8. Then, As Tθ (1802359740,7125) : $p\theta$ (761719338,3223) :: ſo Radius (100000) : 42262,3309 + = Tangent of Angle θTp [by 5th Caſe of right-angled plain Triangles, *Caſwell*] = Tangent of 22°+54′+36″+11‴+55⁗ = Angle ATp,

So from the Angle A C N (A T k) 2d Fig.

$$=\overset{\circ}{23}+\overset{\prime}{39}+\overset{\prime\prime}{26}+\overset{\prime\prime\prime}{19}+\overset{\prime\prime\prime\prime}{21}\,[\text{N.}1.]$$

ſubtracting the Angle A T ρ $\Big\}=22+54+36+11+55$

we have the Remainder equal to the Angle k T ρ,

$$=00+44+56+07+26$$

and Equatⁿ rTν $=00+44+56+33+02$ [Preamble Num. 1.] but Angle k Tρ ſhould = Equation r Tν [by Sect. 2. *Lemma* 6.] ſo this Angle k T ρ being < Angle r T ν by $6''+25'''+36''''$ (by $23136''''$) the Eccentricity C T muſt be > 31800000 to give Angle k T ρ = Equation r T ν, as will appear by the Annotation ſubjoin'd.

Annotation. The Semi-axis A C, in 1ſt and 2d Figures, being determin'd, and the mean Anomaly, the Angle E T ν, in the upper Quadrant of the Circle, in 1ſt Figure, being given, and the Line C N being drawn cutting the Eccentrick in N, in 2d Figure, ſo as to make the Angle A c N = Angle E T ν; the leſs we put the Eccentricity C T, the leſs will ariſe the Angle k T ρ, in 2d Figure; and, on the other Hand, the bigger we put the Eccentricity C T, the bigger the Angle k T ρ will ariſe.

For the leſs C T is put, the leſs we ſhall have T ι'''' and the Arch N δ; and the leſs we ſhall have T γ'''' and the Arch N μ; but the bigger we ſhall have the Arch A μ, and the Arch $\mu\,\delta$ will be the leſs. Again, the leſs C T is put, the bigger will be the acute Angle A c Q (θ c Q) and the bigger will be the Perpendicular Q θ.

All theſe Aſſertions may appear by conſidering the ſeveral Calculations for finding theſe Quantities made uſe of in Numbers 1. 2. 3. 4. and 5. reſpectively, in the Poſitions ſubjoin'd.

Again, the leſs C T is put, the bigger we have $\rho\theta$, but the leſs we have $c\theta$ and $T\theta$, and conſequently the bigger we find the Tangent of the Angle $\theta T\rho$, and the bigger we have the Angle $AT\rho$, as will be manifeſt by conſidering the Calculations in Numbers 6. 7. 8. So that Angle A T k being equal to Angle A C N, the leſs we put the Eccentricity C T, the leſs we ſhall have the Angle A T k—Angle $AT\rho$; that is to ſay, the leſs we ſhall have the Angle $kT\rho$.

On the contrary, the bigger C T is put, the bigger we have $T\epsilon''''$, and the Arch $N\delta$; and the bigger we have $T\gamma''''$, and the Arch $N\mu$; but the leſs we ſhall have the Arch $A\mu$, and the Arch $\mu\delta$ will be the bigger. Again, the bigger C T is put, the leſs will be the acute Angle A c Q (θ c Q) and the leſs will be the Perpendicular $Q\theta$.

Again, the bigger C T is put, the leſs we have $\rho\theta$, but the bigger we have $C\theta$ and $T\theta$; and conſequently the leſs we have the Tangent of the Angle $\theta T\rho$, and the leſs we have the Angle $AT\rho$; as will be manifeſt, by conſidering the Calculations in the ſeveral Numbers of the Poſitions ſubjoin'd. So that the bigger we put the Eccentricity C T, the bigger we ſhall have the Angle A T k — Angle $AT\rho$; that is to ſay, the bigger we ſhall have the Angle $kT\rho$.

2d Poſition. Let the Eccentricity C T be equal to 31877000, equal to $C\varphi$ [ſee below, 3d Poſition, at the End of Num. 9. why I take C T equal to 31877000].

1. Produce N C, in 2d Figure, and draw $T\epsilon$, cutting N C, produced, at right Angles, in the Point ϵ. The Angle $Tc\epsilon$ is given, being equal to the Angle A C N, $=23^{\circ}+39'+26''+19'''+21''''$ [Preamble Num. 2.] = Arch A N.

And the Sine of the Angle T c ε is equal to 40126,5472—. Then ſay,

As the whole Sine (100000) : CT (31877000) : : ſo the Sine of Angle T c ε (40126,5472—) : 12791139,45+ = T ε in Length.

And T ε in 4th Scruples = $4927679''''$,3954 = $22' + 48'' + 47''' + 59''''$,3954 [as in the Proof].

PROOF

For Num. 1.

As Radius C N in Length (1927500000) : T ε in Length (12791139,45+) : : ſo Radius C N'' ($742553239''''$,43+) : [Sect. 2. 2d *Lemma*] to 4927679,3954 = T ε''''.

2. In 2d Figure draw c δ cutting the Arch A N ξ in δ, betwixt N and A, ſo as to make the little Arch N δ = T ε'''' = $22' + 48'' + 47''' + 59''''$,3954. Then we have Arch A δ (Arch A N—Arch N δ) = $23° + 16' + 37'' + 31''' + 21''''$,6046; and we have the Sine of this Angle A c δ = 39517,8263+.

Produce δ c, and draw T γ cutting δ c, produced, at right Angles in the Point γ. The Angle T c γ is given, being = Angle A c δ; ſo the Sine of the Angle T c γ = 39517,8263+. Then ſay,

As the whole Sine (100000) : C T (31877000) : : ſo the Sine of Angle T c γ (39517,8263+) : 12597097,4896 = T γ in Length.

And T γ in 4th Scruples is equal to $4852926''''$,354+ = $22' + 28'' + 02''' + 06''''$+ = T γ'''' [as in the Proof.]

PROOF

For Num. 2.

As Radius CN in Length (1927500000) : Tγ in Length (12597097,4896) : : to Radius CN$''''$ (742553239$''''$,43 +) : 4852926,3545 + = Tγ''''.

3. Out of the Arch AN, in 2d Figure, Arch Nμ. Arch Aμ.

$$= \overset{\circ}{23} + \overset{\prime}{39} + \overset{\prime\prime}{26} + \overset{\prime\prime\prime}{19} + \overset{\prime\prime\prime\prime}{21} \quad \text{[Num. 1.]}$$

take the Arch Nμ = Tγ''''

$$= 00 + 22 + 28 + 02 + 06 + \quad \text{[Num. 2.]}$$

we have the Remainder = Arch Aμ

$$= 23 + 16 + 58 + 17 + 15.$$

Then reaſoning, as in 1ſt Poſition, Num. 3, we find Angle AcQ $<$ Angle AcN. And Angle AcN being = Angle Tc♒ [Num. 1.]; therefore Angle AcQ $<$ Angle Tc♒.

4. Draw Qc, and draw T♉ cutting Qc, produced, at Right Angles in the Point ♉. So the Angle Tc♉ = Angle AcQ.

Then reaſoning as in 1ſt Poſition Num. 4, we have T♌ $<$ T♒, and T♌$''''$ $<$ Arch Nδ, and Arch NQ = T♌$''''$. Arch AQ $<$, Arch Aδ.

So Arch NQ $<$ Arch Nδ; therefore Arch AQ $>$ Arch Aδ.

5. Then reaſoning as in 1ſt Poſition Num. 5, we have Arch NQ $>$ Arch Nμ. So Arch AQ $<$ Arch Aμ. And Arch AQ $>$ Arch Aδ [Num. 4.].

Then the Arch Aμ being equal to

$$\overset{\circ}{23} + \overset{\prime}{16} + \overset{\prime\prime}{58} + \overset{\prime\prime\prime}{17} + \overset{\prime\prime\prime\prime}{15} \quad \text{[N. 3.]}$$

And the Arch Aδ being equal to

$$23 + 16 + 37 + 31 + 21{,}6046 \quad \text{[N. 2.]}$$

Subſtracting, we have the Difference

$$00 + 00 + 20 + 45 + 53{,}3954.$$

Then to the Arch A δ, adding the half Difference $= 10'' + 22''' + 56''''{,}6977$, we have the Sum $= 23^\circ + 16' + 47'' + 54''' + 18''''{,}3 + =$ Angle

Angle A c Q.

A c Q nearly. And the Sine of this Angle A c Q $= 39522{,}4517 + =$ Sine of Angle θ c Q. Then ſay,

Qθ.

As Sine of Q θ c (100000) : Q c (1927500000) : : So Sine of the Angle θ c Q (39522,4517 +): 761795256,5175 = Q θ [by 7th Caſe of right-angled plain Triangles, *Caſwell*].

6. T F = C A = C ξ = 1927500000. C T = 31877000 [Num. 1.] = c φ. And T F □ — c T □ = c F □. [Sect. 2. Lemma 4.]

T F □ = 3715256250000000000

C T □ = 1016143129000000 So

$$\left.\begin{array}{l}\text{FT}\,\square -\\ \text{CT}\,\square\\ (\text{CF}\,\square)\end{array}\right\} = 3714240106871000000.$$

And $\sqrt{}^{2}$ of this = C F = 1927236391,02 — = Half of the conjugate Axis of the elliptical Orbit. Then ſay,

ρθ.

As C ξ (1927500000) : C F (1927236391,02 —) : : So Q θ (761795256,5175) : 761691071,788 + = ρ θ. [Sect. 2. Lem. 5].

7. Angle A c Q being $= 23^\circ + 16' + 47'' + 54''' + 18''''{,}3$ [N. 5.] = Angle θ c Q, we have Angle θ Q c (Complement) $= 66 + 43 + 12 + 05 + 41{,}7$. And the Sine of Angle θ Q c = 91858,4574 —. Then ſay,

As Radius (100000) : Sine of θ Q c (91858, 4574) : : So Q c (1927500000) : 1770571766, 385 + = C θ [by the 7th Caſe of right-angled plain Triangles, *Caſwell*].

Tθ.

So C T being = 31877000 [Num. 1.] we have T c + c θ (T θ) = 1802448766,385.

8. Then, as T θ (1802448766,385) : ρ θ (761691071,788 +) : : So Radius (100000) : 42258,6809 — = Tangent of Angle θ T ρ [by

the 5th Caſe of right-angled plain Triangles, *Caſwell*]. = Tangent of $22^{\circ}+54'+29''+48'''+20''''$ = Angle A T ρ.

So from Angle A c N (A T k) 2d Figure

$$\begin{array}{lrrrrr} & {}^{\circ} & ' & '' & ''' & '''' \\ & =23 & +39 & +26 & +19 & +21 \\ \text{ſubſtracting Ang. A T}\rho & =22 & +54 & +29 & +48 & +20 \\ \hline \end{array}$$

we have the Remainder-Angle k T ρ

Angle k T ρ.

$$\begin{array}{lrrrrr} & =00 & +44 & +56 & +31 & +01 \\ \text{but Equation ♈ T}\nu & =00 & +44 & +56 & +33 & +02 \\ \hline \end{array}$$

[Preamble Num. 1.] So γ T $>$ k T ρ by

$$00+00+00+02+01$$

So the Eccentricity c T muſt be a ſmall matter $>$ 31877000, to give the Angle k T ρ = Equation γ T ν [by the Annotation ſubjoined to the 1ſt Poſition, Num. 8].

3d Poſition. Let the Eccentricity c T = 31877336 = C ϑ [ſee the Note below, ſubjoined to the End of Num. 9. of this 3d Poſition].

3d Poſition C. T.

1. Produce N c in the 2d Figure, and draw T ε cutting N c, produced, at right Angles, in the Point ε. The Angle T c ε is given, being = Angle A c N = $23^{\circ}+39'+26''+19'''+21''''$ [Preamble Num. 2]. = Arch A N.

Arch A N.

And the Sine of Angle T c ε = 40126,5472—. Then ſay,

As the whole Sine (100000) : C T (3 877336) : : So Sine of Angle T c ε (40126,547 +) : 12791274,2 + = T ε in Length.

And T ε in 4th Scruples = $4927731'''',3+$ = $22'+48''+48'''+51'''',3+$ [as in the Proof].

T ε''''.

PROOF

For Num. 1.

As Radius C N in Length (1927500000) : $T\varepsilon$ in Length (12791274.2+) : : So Radius CN'''' ($742553239''''$,43 +) : $4927731''''$,3067 $-=$ $T\varepsilon''''$.

Arch Nδ. 2. In the 2d Figure draw cδ cutting the Arch A Nξ in δ, betwixt N and A, ſo as to make the little Arc $N\delta = T\varepsilon'''' = 22' + 48'' + 48''' + 51''''$,3+. Then we have Arch A$\delta$ (Arch A N − Arch Nδ) $= 23° + 16' + 37'' + 30''' + 29''''$,69+.

Arch Aδ. And we have the Sine of this Angle $Ac\delta =$ 39517,8112.

Produce δc, and draw Tγ cutting δc, produced at right Angles in the Point γ. The Angle T cγ is given, being = Angle A cδ. So the Sine of Angle $Tc\gamma =$ 39517,8112−. Then ſay,

As the whole Sine (100000) : C T (31877,336) : : ſo is the Sine of Angle T cγ (39517,8112 −) : 12597225,456+ = Tγ in Length.

$T\gamma''''$. And Tγ in 4th Scruples = 4852975,6525+ $= 22' + 28'' + 02''' + 55''''$,6525 + $= T\gamma'''$ [as in the Proof.]

PROOF

For Num. 2.

As Radius C N in Length (1927500000) : Tγ in Length (12597225,456+) : : ſo Radius CN'''' ($742553239''''$,43+) : $4852975''''$,6525+$=T\gamma''''$.

3. Out of the Arch AN, in the 2d Figure,

$=23^{\circ}+39'+26''+19'''+21'''$ [Num. 1.]

take the Arch $N\mu = T\gamma''''$ Arch $N\mu$,

$=00+22+28+02+55,6525+$

---

we have the Remainder Arch $A\mu$ Arch $A\mu$.

$=23+16+58+16+25,3475-$

Then, reaſoning as in the 1ſt Poſition, [Num. 3.], we find Angle $AcQ <$ Angle AcN. And Angle AcN being $=$ Angle $Tc\epsilon$ [Num. 1.]; therefore Angle $AcQ <$ Angle $Tc\epsilon$.

4. Draw Qc, and draw $T\gamma$ cutting Qc, produced at right Angles in the Point γ. So Angle $Tc\gamma =$ Angle AcQ.

Then reaſoning, as in the 1ſt Poſition, [Num. 4.] we have $T\gamma <$, $T\epsilon$, and $T\gamma'''' < N\delta$, and Arch $NQ = T\gamma'''$, ſo Arch $NQ <$ Arch $N\delta$; therefore Arch $AQ >$ Arch $A\delta$. Arch $AQ >$, Arch $A\delta$.

5. Then reaſoning as in the 1ſt Poſition, [Num. 5], we have Arch $NQ >$ Arch $N\mu$, ſo Arch $AQ <$ Arch $A\mu$.

On the other hand: Arch $AQ >$ Arch $A\delta$, [Num. 4.]

Then the Arch $A\mu$ being equal to

$23^{\circ}+16''+58''+16'''+25'''',3475$ [Num. 3.]

and the Arch $A\delta$ being equal to

$23+16+37+30+29,6933$ [Num. 2.]

we have the Difference equal to Difference.

$00+00+20+45+55,6542$.

So to the Arch $A\delta$, adding the Half Difference $=10''+22'''57''''$,8271, we have the Sum $=23^{\circ\prime}+16''+47''+53'''27''''$,52+, which I ſhall take to be nearly $=$ Angle AcQ, and the Sine of this Angle AcQ (θcQ,) $= 39522,4415$. Angle AcQ. θcQ.

Then

$Q\theta$. Then ſay, as Sine of $Q\theta c$ (100000) : QC (1927500000) : : ſo Sine of Angle θcQ (39522,4415) : 761795059,9125 $=$ $Q\theta$ [by the 7th Caſe of right-angled plain Triangles, *Caſwell*].

6. $TF = CA = C\xi =$ 1927500000 . $CT = 31877336 = C\varphi$, and $TF\square$, $CT\square$, $= CF\square$. [Sect. 2. *Lemma* 4.]

So we have $TF\square =$ 371525625000000000
and we have $CT\square =$ 1016164550456896

ſo $TF\square$-$CT\square$ ($CF\square$) $=$ 371424008544954 3104
CF. and $\sqrt{}^2$ of this $= CF =$ 1927236385,4622$+$ $=$ $=$ half of the conjugate Axis of the elliptical Orbit.

Then ſay, As $c\xi$ (1927500000) : CF (1927236385,46$+$) : : ſo $Q\theta$ (761795059,91$+$)
$\rho\theta$. : 761690873,0076— $=$ $\rho\theta$ [by Sect. 2. *Lemma* 5.].

7. Angle θcQ being $= 23^\circ + 16' + 47'' + 53''' + 27'''',52+$ [Num. 5.] we have Angle θQc the Complement $= 66 + 43 + 12 + 06''' + 32'''',48$; and we have the Sine of Angle $\theta Qc = 91858,46$. Then ſay,

$c\theta$. As Radius (100000) : Sine of θQc (91858,46) : : ſo Qc (1927500000) : 1770571816,5 $= c\theta$ [by 7th Caſe of right-angled plain Triangles, *Caſwell*].

So cT being $=$ 31877336 [Num. 1.] we have
$T\theta$. $Tc + c\theta$ ($T\theta$) $=$ 1802449152,5.

8. Then, As $T\theta$ (1802449152,5) : $\rho\theta$ (761690873,01) : : ſo Radius (100000) : 42258,6608$+$ $=$ Tangent of Angle $\theta T\rho$ [by 5th Caſe of right-angled plain Triangles, *Caſwell*] $=$ Tangent of $22^\circ + 54'' + 29'' + 45''' + 22'''' =$
Angle $AT\rho$. Angle $AT\rho$.

So from the Angle ACN (ATk) 2d Fig. ſub-

$$=23^{\circ}+39'+26''+19'''+21''''\ \text{[N. 1.]}$$

ſubſtracting the Angle A T ρ $\Big\}=22+54+29+45+22$

we have Remainder = Angle k T ρ, Angle k T ρ.

$$=00+44+56+33+59$$

and Equat. ♈ T ν $=00+44+56+33+02$ [Preamble [Num. 1.], ſo Angle k T ρ here > Equation ♈ T ν [by 57'''', ſo this Angle k T ρ being > Equation ♈ T ν, the Eccentricity c T ſhould be ſomething < 31177336 to give Angle k T ρ = Equation ♈ T ν [by the Annotation ſubjoined to 1ſt Poſition, Num. 8.]

9. On putting C T = 31877000, we have Angle k T ρ < Equation ♈ T ν, by 2'''+01'''', or by 121'''' [2d Poſition, Num. 8.]. This I call, a. a.

And on putting C T = 31877336, we have Angle k T ρ > Equation ♈ T ν, by 57'''' [3d Poſition, Num. 8.]. This I call, b. b.

Then from 31877336, ſubſtracting 31877000, we have the Remainder = 336, which I call, D. D.

Let D be divided, ſo as that a proportional Part of it ſhall correſpond to b, which I call, x. x.

So the Part correſponding to a, will be D—x. D—x.

Then ſay,

As $b : a :: ſo\ x : D-x$, ſo $ax = bD - bx$, ſo $ax + bx = bD$, ſo $x = \frac{bD}{a+b}$, where $bD = 19152$, and $a+b = 178$.

So $x = 107{,}5955$, ſo $D - x = 228{,}4045$—.

Then from 31877336, ſubſtracting the Part correſpondent to b = 107,5955 = x, we have the Remainder = 31877228,4045 for a new c T.

Or to 31877000 Adding the Part correſpondent to a = 228,4045 = D—x, we have the Sum = 31877228,4045 for a new c T.

So I ſhall take 31877228 for the Eccentricity of the Sun's elliptical Orbit, c T, proportioned to the tranſverſe Axis AB = 1927500000 × 2. (=cA×2) ſo as that in calculating according to the Form of the 1ſt Poſition, we ſhall find, in the 8th Operation, the Equation of the Orbit correſponding to the mean Adomaly $=23^{\circ}+39'+26''+19''+21'''$, to ariſe $=44'+56''+33'''+02''''$, or very nearly ſo. See the Note below.

1ſt *Lemma.*] From the two Foci T and Φ, in 1ſt Figure draw T a and T Φ a, cutting the Semicircle E a I and the Semi-ellipſe A F B in the Point of their common Interſection a; and draw T F and Φ F.

Then we have the Angle A T a $=89^{\circ}+17'+21''+25+11''''$— For,

From the Point a draw a ε, cutting the Line of Apſes B T Φ at right Angles in ε. The Eccentricity C T (C Φ) being = 31877228 [3d Poſition, Num. 9]. we have T Φ = 63754456 = b. Call T ε = X. So Φ ε = b — X.

C T.

b –X.

Here Φ F being = C A = T F, = 1927500000 [3d Poſition, Num. 9]; and Φ F □ − C Φ □ being = C F □ [Sect. 2. Lem. 4]; we have

Φ F □ =37152562500000000
and C Φ □ =1016157664963984

So Φ F □ — C Φ □ = C F □ = } =37142400923350360016

C F. And $\surd^2$ of this = C F = 1927236387,2486 = half of the conjugate Axis of the elliptical Orbit.

Here T a is the Radius of the Circle E a I b, and is a middle Proportional betwixt C A and C F [Chap 4. Sect. I. Num. 3]. So

CA × cF = 3714748136421676500

And $\sqrt{}^{2}$ of this = 1927368189,1174 — = T a. T a

Then T a + Φ a being = A B = 385500000 [by Prop. 52. of *Apollonius*'s *Conicks*, Book 3d] ſubſtracting T a from AB, we have the Remainder = 1927631810,8826 + = Φ a.

Call T a = C. Call Φ a = d. Call a ε = p: Then T ε being = x, we have cc = pp + xx. and dd = pp + bb — 2 b x + x x. ſo d d — cc = b b — 2 b x. So b b + cc — d d = 2 b x. So $x = \frac{bb + cc - dd}{2b}$: Where b being = T Φ, we have b b = 4064630659855936. And d + c (A B) being = 3855000000,0000. And d — c (Φ a — T a) being = 263621,7652, we have the Product of theſe two laſt = 1016261905231500 = d d — c c. So ſubſtracting this out of b b, and dividing by 2 b, we have $\frac{bb + cc - dd}{2b}$

$\frac{3048368754624436}{127508912}$ = 23907103,4864 + = X = T ε. Then ſay,

As T a ε (1927368189,1174 —) : Radius (100000) : : ſo T ε (23907103,4864 +) : 1240,4015 — = Sine of Angle T a ε [by 4th Caſe of right angled plain Triangles, *Caſwell*]. = Sine of 0° + 42′ + 38″ + 34‴ + 49⁗ + = Angle T a ε. So we have Angle ε T a = 89 + 17 + 21 + 25 + 11 — = Complement = Angle A T a. T ε

2d *Lemma*.] 1. Let the true Anomaly, A T a in 1ſt Figure = 89° + 17′ + 21″ + 25‴ + 11⁗ —. And let the Equation of the Orbit correſponding thereto, be the Angle a T ν. So the elliptical Portion A T a (Sector E T a + curvilinear Triangle A a E) = Sector E T ν, which is the mean Anomaly correſponding. So the Sector a T ν, Angle A T a.

comprehending the Angle of the Equation = the Area of the curvilinear Triangle A a E [Chap. 4. Sect. 1. Numbers 4 and 5].

Angle ATρ. 4th Figure. 2. Let the Angle ATρ, in the 4th Figure =89°+17′+21″+25″+11‴— the Line Tρ cutting the Semi-ellipſe A F B in ρ.

This Angle ATρ repreſents the true Anomaly AT a in the 1ſt Figure.

Draw Qθϑ cutting the Diameter B T A at right Angles in the Point θ, and cutting the Semicircle A ξ B in Q.

Then, becauſe the Ellipſe A F B G, in the 4th Figure, is of the ſame Bigneſs and Species with the Ellipſe in the 1ſt Figure [Chap. 4. Sect. 1. Num. 3.]; and becauſe the Angle ATρ in the 4th Figure = Angle AT a in the 1ſt Figure; therefore Line Tρ in the 4th Figure = Ta in the 1ſt Figure.

So the Angle ATρ (Angle θTρ) being
=89°+17′+21″+25‴+11⁗–
we have Angle Tρθ (complement)
=00 + 42 + 38 + 34 + 49 +
And we have the Sine of this Complement
= 1240,4015 —

Tρ. And we have Tρ = 1927368189,1174 — = T a [1ſt *Lemma*]. Then ſay, As the whole Sine (100000): Tρ (1927368189,1174—) :: ſo Sine of Complement (1240,40+): 2390-

Tθ. 7075,02 — = Tθ.

3. Angle θTρ being = 89°+17′+21″+25‴+11⁗—, we have the Sine of it = 99992,3067. And Angle Tθρ being a right Angle, and the Hypothenuſe Tρ being = 1927368189,1174— [Num. 2.] ſay,

As the whole Sine (100000): Tρ (1927368189.1174) : : ſo Sine of Angle θTρ (99992,3067):

1927219910,9 = ρθ [by the 7th Caſe of right-angled plain Triangles, *Caſwell*]. ρθ.

4. Cξ = 1927500000. CF = 1927236387,2486 1ſt *Lemma*]. Then ſay,

As CF (1927236387,2486) : Cξ (1927500000) : : ſo ρθ (1927219910,9) : 1927483521,398 — = Qθ [Sect. 2. Lemma 5.] Qθ.

5. From the Centre, draw CQ cutting the Eccentrick in Q. Then Radius CQ being = 1927500000, and Angle CθQ being a right Angle, ſay,

As Radius CQ (1927500000) : whole Sine (100000) : : ſo Qθ (1927483521,398 : 99999,14508 — = Sine of Angle θCQ = Sine of Angles θcQ. $89^{\circ}+45'+40''+42'''+40''''$ = Angle BCQ BcQ. [by the 3d Caſe of right-angled plain Triangles, *Caſwell*]. Draw T♈ cutting CQ at right Angles in the Point ♈. So Angle Tc♈ = Angle BcQ. Then ſay,

As Sine of Angle T♈c (100000) : CT (31877228) : : ſo Sine of Angle Tc♈ (99999,145 +) 31876955,45 = + = T♈ in Length, [by the 7th Caſe of right-angled plain Triangles, *Caſwell*].

And T♈ in the 4th Scruples = $12280330''''$, T♈''''. $237+ = 56'+51''+12'''+10''''$,237 + = T♈ [as in the Proof].

PROOF

For Num. 5.

As Radius CQ in Length (1927500000) : T♈ in Length (31876955,45 —) : : So Radius CN'''' (742553239,43) : 12280330,2374 — T♈''''.

6. From C draw CN below Q, cutting the Eccentrick in N, ſo as to make the Angle QcN = $56'+51''+12'''+10''''$,237 +. Angle QcN.

Arch N Q.

Then T ♈ being drawn ſo as to cut c Q at right Angles in the Point ♈ [Num. 5.] we have Triangle T c Q = a right-angled Triangle, whoſe Area = half C Q × T ♈ [Sch. Prop. 41ſt of 1ſt Element]; and we have the Sector Q c N = a right-angled Triangle, whoſe Area = half c Q × Arch N Q [Coroll. from Sect. 2. Lemma 3.] and Angle Q c N being $= 56' + 51'' + 12''' + 10'''',237$, we have Arch N Q $= 56' + 51'' + 12''' + 10'''',237 =$ T γ'''' [Num. 5.]; therefore Triangle T c Q = Sector Q C N.

Then the Portion of the Eccentrick A T Q being = Sector A c Q + Triangle T c Q; and the Sector A c N being = Sector Q c N, therefore the Portion A T Q = A c N.

7. The Portion of the Eccentrick A T Q: is to the elliptical Portion A T ρ : : as θ Q : θ ρ [Sect. 2. Lemma 6.]: And the Portion A T Q being = Sector A c N [Num. 6.] therefore Sector A c N : to elliptical Portion A T ρ : : as θ Q : θ ρ. And becauſe Angle A T a, in 1ſt Figure, = Angle A T ρ, in 4th Figure [Numbers 1 and 2], becauſe all the Ellipſes in both Figures are equal to each other, and of the ſame Species [Chap. 4. Sect. 1. Num. 3]; therefore Segment A T ρ, in 4th Figure, = Segment A T a, in 1ſt Figure: therefore Sector A c N, in 4th Figure : to Segment A T a in 1ſt Figure : : as θ Q : θ ρ. Alſo becauſe Segment A T a = Sector E T κ, in 1ſt Figure [Num. 1.] therefore Sector A c N, in 4th Figure : to Sector E T κ, in 1ſt Figure : : As θ Q : θ ρ : : As the Eccentrick Circle A ξ B x, in 4th Figure : to the Circle E a I b in 1ſt Figure [Sect. 2. Lemma 6], ſo Sector A c N in 4th Figure : to Sector E T κ in 1ſt Figure : : As Circle A ξ B x : to Circle E a I b. Conſequently Angle A c N = Angle E T κ.

8. Angle BcQ being } $=89^\circ+45'+40''+42'''+40''''$ Angle BcQ.

[Num. 5]. ſubtract this from 180°, we have remaining $=90^\circ+14+19+17+20=$ Supplement $=$ Angle AcQ. Adding hereto Angle QcN $=00+56+51+12+10{,}237$, [Numb. 6.] we have the Sum $=$ Angle AcN $91+11+10+29+30{,}237=$ Angle E T κ.

A c Q.

Angle A c N.

E T κ.

Draw T k parallel to C N, cutting the Eccentrick in k. Then Angle AT k $=$ Angle A c N, and from Angle A c N ſubſtracting Angle AT ρ $=89^\circ+17'+21''+25'''+11''''-$ [Num. 2.] we have the Remainder $=01+53+49+04+19{,}237=$ Angle k T ρ $=$ Equation of the Orbit correſponding to the mean Anomaly E T κ in 1ſt Figure $=$ Angle a T κ in 1ſt Figure [Sect. 2. Lemma 6].

Equation k T ρ.

9. And this is the greateſt Equation of the Sun's Orbit which can be found throughout the Semicircle E a I, *viz.* in the Sun's Deſcent from the *Apogæum* to the *Perigæum*.

Greateſt Equation of the Sun's elliptick Orbit.

For the Area of the Sector a T κ, comprehended by the Angle of Equation a T κ, is equal to the whole curvilinear Triangle A a E, the Sector E T κ, being equal to the elliptical Segment A T a [Num. 1]; whereas if, on the one hand, the mean Anomaly E T ν be leſs than E T κ, then the Area of the Sector ♈ T ν, comprehended by the correſponding Angle of Equation ♈ T ν, is equal to no more than the curvilinear *Trapezium* A δ r E; and if on the other hand, the mean Anomaly E T g be more than the mean Anomaly E T κ, then the Area of the Sector S T g, comprehended by the correſponding Angle of Equation S T g, is equal to no more than the curvilinear Triangle A a E —

the curvilinear Triangle γ a S [Chap. 4. Sect. 1. Num. 4].

COROLLARY I.

Firſt Corollary.

Firſt, Hence the bigger the mean Anomaly is, provided it doth not exceed $91^\circ + 11' + 10'' + 29''' + 30''''$,257, the bigger we have the Equation of the Orbit correſponding.

But the bigger the mean Anomaly is, when it exceeds $91^\circ + 11' + 10'' + 29''' + 30''''$,257, the leſs we have the Equation of the Orbit correſponding.

1ſt Caſe, as Lemma 2d, Num. 8.

1ſt Caſe: In the firſt Figure, Let the mean Anomaly $ET\lambda$ be $>$ the mean Anomaly $ET\gamma$, but $< 91^\circ + 11' + 10'' + 29''' + 30''''257$, ſc. $<$ the mean Anomaly $ET\varkappa^a$. Let the Angle $\varkappa T\lambda$ be the Equation of the Orbit correſponding to the mean Anomaly $ET\lambda$, and let the Angle ♈ T γ be the Equation of the Orbit correſponding to the mean Anomaly $ET\gamma$.

Through the Points T and γ, draw the Lines $T\tau\theta$, and T ♈ δ, cutting the elliptical Arch A F a in the Points θ and δ, reſpectively. Then the Area of the Sector $ET\lambda$ being $=$ the elliptical Area $AT\theta$, we have the Area of the Sector $\tau T\lambda$ comprehended in the correſponding Angle of Equation $\tau T\lambda =$ the curvilinear Trapezium $EA\theta\tau$; whereas the Area of the Sector $ET\gamma$ being $=$ the elliptical Area $AT\delta$, we have the Area of the Sector ♈ T γ (comprehended in the correſponding Angle of the Equation ♈ T γ) $=$ the curvilinear Trapezium E A δ ♈ [Chap. 4. Sect. 4 Num. 4.].

But the curvilinear Trapezium $EA\theta\tau$ being $>$ curvilinear Trapezium E A δ ♈, conſequently the Equation of the Orbit correſponding to the bigger mean Anomaly $ET\lambda >$ the Equation of the Orbit correſponding to the leſſer mean Anomaly E T γ.

Upper Sector.
Lower Sector.

Note here, I call the Sector E T κ, the upper Sector; and I call the Sector κ T I, the lower Sector of the Semicircle E a I.

Upper Segment.
Lower Segment.

Alſo, I call the elliptical Area A T a, the upper Segment; and I call the elliptical Area a T B, the lower Segment of the Semi-ellipſe A F B.

2d Caſe.

2d Caſe: In firſt Figure, Let the mean Anomaly E T g be > the mean Anomaly E T C, which yet is > $91^\circ + 11' + 10'' + 29''' + 30''''$,257. So the Point g is found in the lower Sector of the Semicircle E a I.

Let the Angle S T g be the Equation of the Orbit correſponding to the mean Anomaly E T g, and let the Angle i T C be the Equation of the Orbit correſponding to the mean Anomaly E T C. Let the Points π and γ be the common Interſections of the Lines T g and T S, with the elliptical Arch a B reſpectively; and the Points w and t be the common Interſections of the Lines T C and T i, with the elliptical Arch a B reſpectively.

Then the Area of the Sector E T g being = the elliptical Area. A T γ, we have the Area of the Sector S T g (comprehended in the correſponding Angle of Equation S T g) = the curvilinear Triangle E A a — the curvilinear Triangle S a γ; whereas the Area of the Sector i T C (comprehended in the correſponding Angle of Equation i T C) — the curvilinear Triangle E A a — the curvilinear Triangle i a t [Chap. 4. Sect. 1. Num. 4.].

But the curvilinear Triangle S a γ is > the curvilinear Triangle i a t, conſequently, the leſs we have the Equation of the Orbit correſponding to the bigger mean Anomaly E T g, in this Caſe.

Co-

COROLARY II.

Second Corollary.

Hence when Angle A c N, in 3d Figure, is $> 91^\circ + 11' + 10'' + 29'''' + 30''',237$, then the Angle T c ♈ is acute. For,

When Angle A c N $= 91^\circ + 11' + 10'' + 29''' + 30'''',237+$, then Angle A c Q $= 90^\circ + 14' + 19'' + 17''' + 20''''$, [Num. 8.]; and then Angle B c Q (Angle T c ♉ Supplement) is acute. Much more Angle T c ♉ muſt be acute, when Angle A c N $> 91^\circ + 11' + 10'' + 29''' + 30'''',237+$].

Lemma 3. In 1ſt Figure: Let the Sun's mean Anomaly, the Angle E T γ, be in the upper Sector of the Semicircle E a I, the Angle ♈ T $\varkappa$ being the Equation of the Orbit correſponding to E T γ.

Let the Angle γ T g be given, being the Sun's middle Motion in its Orbit in a determinate Quantity of equal Time; and let this Angle γ T g be ſo large as that the Sum of the two Angles E T γ and γ T g ſhall be $>$ the Angle E T $\varkappa$; ſcil. this Sum ſhall exceed $91^\circ + 11' + 10'' + 29''' + 30'''',237$. Then the Sun's mean Anomaly E T g will bring the Point g into the lower Sector of the Semicircle E a I [2d *Lemma*, 2d Caſe].

Let the Angle S T g be the Equation of the Orbit correſponding to the mean Anomaly E T g, and let the Equation S T g be $>$ the Equation ♈ T γ.

Alſo let Equation S T g — Equation ♈ T γ = f, where f is a known determinate Quantity.

Then aſſuming ſome Quantity for the mean Anomaly E T γ, and determining the mean Anomaly E T g thereby, and accordingly calculating for finding the Equations of the Orbit ♈ T ν,

♈ T v, and S T g, if the Equation S T g — Equation ♈ T v, be > f, it ſhews, that we muſt take E T v bigger.

But, if, upon the Reſult, Equation S T g — Equation ♈ T v be < f, it ſhews that we muſt take E T leſs.

For the bigger we take E T v, the bigger the Equation ♈ T v will be [by Coroll. from 2d *Lemma*, 1ſt Caſe].

Then the Angle v T g being a determinate Quantity of ſuch Largeneſs as is deſcribed, the bigger we take the Angle E T v, the bigger we have the mean Anomaly E T g; but the leſs we have the correſponding Equation S T g [by the 1ſt Corol. from 2d *Lemma*, 2d Caſe]; conſequently, when Equat. S T g — Equat. ♈ T v > f, in order to bring Equat. S T g — Equat. ♈ T v = f, we muſt take the mean Anomaly E T v, bigger.

On the other hand: The leſs we take the mean Anomaly E T v, the leſs the Equation ♈ T v will be [by the Reverſe of the 1ſt Corollary from the 2d *Lemma*, 1ſt Caſe]. And the leſs we ſhall have the mean Anomaly E T g; but the bigger we have the correſponding Equation S T g [by the Reverſe of the 1ſt Corollary from 2d *Lemma*, 2d Caſe]; conſequently, when Equation S T g — Equation ♈ T v, is < f, in order to bring Equation S T g — Equation ♈ T v = f, we muſt take the mean Anomaly E T v, leſs.

Note here, That the Equations correſponding to all Degrees, *&c.* of mean Anomaly in the upper Sector, of the firſt Figure, (E T ϰ) are to be calculated by the Operations applicable to the 2d Figure for Sect. 3. whereas the Equations correſpondent to Degrees, *&c.* in the lower Sector, are to be calculated by the Operations applicable to the third Figure for Sect. 3. Note.

2d Proceeding. 2d Proceeding.] In 1ſt Figure, let the mean Anomaly E T ♈ = 23° + 39′ + 26″ + 19‴ + 21⁗ [as in the Preamble, Num. 1.]. Add thereto the Angle ♈ T g = 4 Sig. + 07° + 07′ + 56″ + 14‴ + 24⁗, which was the Sun's middle Motion in its Orbit in thoſe 128 Days + 23 Ho. + 43 Min. + 32 Sec. + 05 Th. + 08 Fo. of equal Time (in thoſe 129 apparent Days) betwixt Noon, at *Greenwich*, on the 14th Aſtronomical Day of *July* (*Old Stile*) and Noon on the 20th Day of *November* (*Old Stile*) next following [Sect. 1. Num. 11].

Then we have the Sum of theſe two Angles,
Mean Anomaly E T g. the mean Anomaly E T g = 5 Sig. + 00° + 47′ + 22″ + 33‴ + 45⁗. So g is in the lower of the Semicircle E a I, from Lemma 2. 1ſt Coroll. Caſe 1.

C T. Let the Eccentricity C T = 31877228 [as in 3d Poſition, Num. 9].

1. In 3d Figure draw the Line C N, cutting the Eccentrick in N, ſo as to make the Angle A c N = Angle E T g; and from the lower Focus T, draw T k parallel to C N. So Angle
Arch A ξ N. A T k (Arch A ξ N) = 5 Sig. + 00° + 47′ +
Arch B N. 22″ + 33‴ + 45⁗. So the Angle B c N (Supplement = 0 + 29 + 12 + 37 + 26 + 15. And the Sine of this Angle B c N = 48801,786.

Draw T ε cutting N c at right Angles in the Point ε. So the Angle T c ε = Angle B c N, and the Sine of Angle T c ε = Sine of Angle B c N.

Then ſay, As the whole Sine (100000) : C T (31877228) : : ſo Sine of Angle T c ε (48801, 786) : 15556656,59 + = T ε in Length. And T ε in 4th Scruples = 5993071⁗,7227 = 27′ +
T ε⁗. 44″ + 44‴ + 31⁗,7227 = T ε⁗ [as in the Proof].

PROOF

PROOF

For Num. 1.

As Radius CN in Length (1927500000) : Tε in Length (15556656,59+) : : So Radius CN'''' $(742553239'''',43+)$: $= T\varepsilon''''$.

2. In 3d Figure draw cδ, cutting the Arch AξN in δ, betwixt N and A, ſo as to make the little Arch $N\delta = T\varepsilon = 27'+44''+44''+31'''',7+$ [Num. 1]. Then we have Arch Bδ (Arch BN + Arch Nδ) $= 29^\circ+40'+22''+10'''+46'''',723-$. And we have the Sine of this Angle $Bc\delta = 49504,6686$.

Arch Nδ.

Arch Bδ.

Draw Tγ cutting cδ at right Angles in the Point γ. The Angle Tcγ is given, being = Angle Bcδ; and the Sine of Angle Tcγ = Sine of Angle Bcδ. Then ſay,

As the whole Sine (100000) : cT (31877228) : : So Sine of Angle Tcγ (49504,669−) : $15780716,2077+ = T\gamma$ in Length. And Tγ in 4th Scruples $= 6079388'''',815- = 28'+08''+43'''+08'''',815-$ [as in the Proof].

$T\gamma''''$.

PROOF

For Num. 2.

As CN Radius (1927500000) : Tγ in Length (15780716,208) : So Radius CN'''' $(742553239'''',43+)$: $6079388,815- = T\gamma''''$.

3. Out of the Arch $N\mu = T\gamma'''' =$ $\}$ $28+08+43+08,815-$ Arch Nμ.

Take the Arch $N\delta = 27+44+44+31,723$

[Num. 2.] we have Remainder = Arch δμ $= 00+23+58+37,092$ Arch δμ.

Then,

Then, becauſe by the Suppoſition [Chap. 4. Sect. 1. Num. 8.] the Portion of the Eccentrick A T Q (Sector A c Q + Triangle T c Q) = Sector A c N = Sector A c Q + Sector Q c N, therefore the Triangle T c Q = Sector Q c N. And becauſe the Angle c T Q is below the Centre c, therefore the Point Q muſt be found betwixt the Points N and A, in the Arch A ♌ N. Conſequently Angle A c Q < A c N; therefore Angle B c Q > Angle B c N. And Angle B c N being = Angle T c ɛ [Num. 1.]; therefore Angle B c Q > Angle T c ɛ.

Angle T c ♈ = Angle B c Q.

4. Draw Q c, and draw T ♈ cutting Q c at right Angles in the Point ♈. So Angle T c ♈ = B c Q; and Angle B c Q being > Angle T c ɛ, [Num. 3.] we have Angle T c ♈ > Angle T c ɛ. So becauſe Angle T c ♈ is acute [as in the 2d Corollary from 2d Lemma], we have T ♈ > T ɛ, therefore T ♈'''' > T ɛ''''.

T ♈''''. >. Arch N ♌.

And T ɛ'''' being = Arch N ♌ [Num. 2.] we have T ♈'''' > Arch N ♌.''''.

Then becauſe T ♈ cuts c Q at right Angles in the Point ♈, we have T ♈ the Altitude of the Triangle T c Q upon the Baſis (upon the Radius) Q c [by Definition 4th of 6th Element]. And the Triangle T c Q being = Sector Q c N, being a Triangle right-angled at N, whoſe Leg c N is the Radius of that Circle = Radius Q c, and whoſe other Leg, or Altitude, = Arch N Q [Sect. 2. Corollary from 3d Lemma]; and T ♈ being the Altitude of the Triangle T c Q upon the Radius Q c; conſequently T ♈ in 4th Scruples (T ♈'''') = N Q.

T ♈'''' =. Arch N Q.

And becauſe T ♈'''' > Arch N ♌, therefore Arch N Q > Arch N ♌; and therefore Angle B Q c > Angle B c ♌.

5. Becauſe Angle T c ♈ = Angle B c Q; and becauſe Angle B c Q > Angle B c ♌ [Num. 4.]; be-

becauſe alſo Angle T c γ = Angle B c δ [Num. 2]. therefore Angle T c ♈ > Angle T c γ; and becauſe Angle T c ♈ is acute, [Num. 4.] therefore T ♈ > T γ, and therefore T ♈'''' > T γ''''. and T ♈'''' and T γ'''' being = Arches N Q and N μ reſpectively, [Num. 4. and 3.] therefore Arch N Q > Arch N μ.

Then Arch N μ — Arch N δ being = Arch δ μ, which is an Affirmative Quantity [Num. 3]; therefore Arch N μ > Arch N δ; conſequently the Point μ is found betwixt the Points δ and Q, in the Arch of the Eccentrick ξ N B.

Then to the Arch B N

Sig. ° ′ ″ ‴ ⁗

=0+29+12.+3.7+2.6+1.5. [N. 1].

Adding the Arch N μ

=0+00+28+08.+43.+08;815—

and adding thereto Arch δ μ

=0+00+00+23+5.8+37,092

we have the Sum

=0+29+41+10+08+00,907

which I ſhall take to be nearly = Angle B c Q = Angle B c Q.

Arch B Q. Arch B Q.

And the Sine of it = 49524,866 + = Sine of Angle θ c Q. Then ſay, Angle θ c Q.

As Sine of Angle Q θ c (100000) : Q C (1927500000) : : ſo Sine of Angle θ c Q (49524, 866 +) 954591792,15 + = Q θ [by 7th Caſe of right-angled plain Triangles, *Caſwell*]. Qθ.

6. C ξ = C A = 1927500000. C F = 1927236387,249— [1ſt Lemma]. Then ſay,

As C ξ (1927500000) : C F (1927236387, 249—) : : ſo Q θ (954591792,15+) : 954461238,2883 + = ρ θ [Sect. 2. Lemma 5]. ρθ.

7. Angle θ c Q being = 0 Sig. $+29^{\circ}+41'+10''+08'''+00'''',907$ [Num. 5]; we have

Angle θQc (Complement) = 2 + 00 + 18 + 49 + 51 + 59,093.

And the Sine of this Angle θQc = 86875,126. Then ſay, As Radius (100000) : Sine of θQc (86875,126) : : ſo Radius Qc (1927500000) :
cθ. 1674518053,65 = cθ [by 7th Caſe of right-angled plain Triangles, *Caſwell*].

So cT being = 41877228 [Num. 1], we
Tθ. have cθ — cT = 1642640825,65 = Tθ.

8. Then, As Tθ (1642640825,65) : $\rho\theta$ (954461238,2883), ſo Radius (100000) : 58105,2914— = Tangent of Angle θTρ [by 5th Caſe of right-angled plain Triangle, *Caſwell*]. = Tangent of 30° + 09′ + 31″ + 52‴ + 55⁗ =
Angle BTρ. Angle BTρ. So the Supplement of this =
Angle ATρ. Angle ATρ
= 4 Sig. + 29° + 50′ + 28″ + 07‴ + 05⁗ + ATρ. Subſtracting this from Angle AcN (Angle ATk) 3d Figure = 5 + 00 + 47 + 22 + 33 + 45, we
Equation kTρ. have the Remainder = Angle kTρ
= 0 + 00 + 56 + 54 + 26 + 40 = Equation of the Orbit correſponding to the mean Anomaly ETg = 5 Sig. + 00° + 47′ + 22″ + 33‴ + 45‴.

So putting this Angle kTρ for Equation STg, and taking Angle kTρ in 3d Poſition, Num. 8. above, for Equation rTν there, we have Equation STg = 56′ + 54″ + 26‴ + 40⁗, and we have Equation ♈Tν
= 44 + 56 + 33 + 02.
So we have Equation STg — Equation rTν
= 11 + 57 + 53 + 38.
But Equation STg — Equation rTν = f
= 8 + 12 + 59 + 59
[Sect. 1. Num. 11.]; therefore Equation STg — Equation rTν here is bigger than it ſhould be (is bigger than f); and therefore, by the 3d Lemma, the mean Anomaly ETν, in 1ſt Figure,

muſt be taken $> 23^{\circ}+39'+26''+19'''+21''''$; to which mean Anomaly the Equation $44'+56''+33'''+02''''$ correſponds [Preamb. Num. 1.]. And I ſhall determine the exact Quantity of the mean Anomaly E T ν, which gives Equation S T g — Equation r T ν = f, by ſome Poſitions in my 3d Proceeding: As follows:

1ſt Poſition }
1ſt Inſtance } Let the mean Anomaly E T ν, in the upper Sector of the Semicircle E a I, in 1ſt Figure, $= 24^{\circ}+41'+30''$. Let the Eccentricity c T = 3187728 [as in 1ſt Inquiry, 3d Poſition, Numb. 9.].

3d Proceeding mean Anomaly E T ν.
c T.

1. In 2d Figure, draw the Line CN cutting the Eccentrick in N, ſo as to make the Angle A c N = Angle E T ν, and from the lower Focus, T, draw T k parallel to CN; ſo Angle A c N = Angle A T k $= 24^{\circ}+41'+30''$ = Arch A N.

Angle A c N.
A T k.
Arch A N.

Produce N C, and draw T E cutting N c, proceeding at right Angles in E. The Angle T c E is given, being = Angle A c N. And the Sine of the Angle T c E = 41773,495. Then ſay, As the whole Sine (100000) : C T (31877228) : : ſo Sine of Angle T c E (41773,495) : 13316232,2447+ = T E in Length, and T ε in 4th Scruples $= 5129967''''$ $= 23'+44''+59'''+27''''$ [as in the Proof] $= T\varepsilon''''$.

$T\varepsilon''''$.

PROOF

For Num. 1.

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As Radius CN in Length (1927500000) : T ε in Length (13316232,2447+) : : So Radius CN'''' $(742553239'''',43 +)$: $5129967''''- = T\varepsilon''''$.

2. In

N δ.

Angle A c δ.

2. In 2d Figure draw c δ cutting the Arch A N ξ in δ, betwixt N and A, ſo as to make the little Arch N δ = T ε$''''$ = $23'+44''+59'''+27''''$. Then we have the Arch A δ (Arch AN—Arch Nδ) = $24^\circ+17'+45''+00'''+33''''$ = Angle A c δ; and we have the Sine of Angle A c δ = 41144,8104.

T γ$''''$

Produce δ c, and draw T γ cutting δ c, produced, at right Angles, in the Point γ. The Angle T c γ is given, being = Angle A c δ, and the Sine of it is given. Then ſay, As the whole Sine (100000) : c T (31877228) :: So Sine of Angle T c γ (41144,8104) : 13115825,02+ = T γ in Length. And T γ in 4th Scruples = 5052761$''''$,7932 = $23'+23''+32'''+41''''$,7932.

PROOF

For Num. 2.

As CN in Length (1927500000) : T γ in Length (13115825,02+) :: So Radius CN$''''$ (742553239$''''$,43+) : 5052761$''''$,7932 = T γ$''''$.

N μ.

A μ.

3. Out of the Arch A N, in 2d Figure:

$$=\overset{\circ}{24}+\overset{\prime}{41}+\overset{\prime\prime}{30}+\overset{\prime\prime\prime}{00}+\overset{\prime\prime\prime\prime}{00}\ \text{[Num. 1.]}$$

take the Arch N μ = T γ$''''$

$$=00+23+23+32+41,79+$$

we have the Remainder = Arch A μ

$$\overline{=24+18+06+27+18,21-}$$

Then reaſoning as in 1ſt Inquiry, 1ſt Poſition, Numb. 3. we find Angle A c Q < Angle A c N. And Angle A c N being = Angle T c ε [Numb. 1.], therefore Angle A c Q < Angle T c ε.

4. Draw Q c, and draw T ♑ cutting Q c, produced, at right Angles, in the Point ♑. So Angle T c ♑ = Angle A c Q.

Angle T c ♑
Angle A c Q.

And Angle A c Q being < Angle T c ε [Num. 3.], we have Angle T c ♑ < Angle T c ε.

Then reaſoning as in the 1ſt Inquiry, 1ſt Poſition, Num. 4. we have T ♑ < T ε, and $T\,♑''''$ < Arch N δ, and Arch N Q = $T\,♑''''$.

So Arch N Q < Arch N δ; therefore Arch A Q > Arch A δ.

Arch A Q.
> Arch A δ.

5. Then reaſoning as in the 1ſt Inquiry, 1ſt Poſition, Num. 5; we have Arch N Q > Arch A μ; ſo Arch A Q < Arch A μ, and Arch A Q > Arch A δ [Num. 4.].

So we find the Point Q betwixt the Points δ and μ in the Arch of the Eccentrick A N ξ.

Then having Arch A μ } $=\overset{\circ}{24}+\overset{\prime}{18}+\overset{\prime}{06}+\overset{\prime\prime\prime\prime}{27}+\overset{\prime\prime\prime\prime}{18},21$ [n. 3.]
And having Arch A δ } $=24+17++45+00+33$ [n. 2.]
we have the ———————————
Difference = μδ = $00+00+21+26+45,21$

μ δ.

Then to the Arch A δ adding the half Difference, $=10''+43'''+22'''',6$ we have the Sum $=24^\circ+17'+55''+43'''+55'''',6$; which I ſhall take to be = Angle A c Q nearly; and the Sine of it = 41152,466 = Sine of Angle θ c Q. Then ſay,

Angle A c ε
θ c Q.

As Sine of Q θ c (100000) : Q c (1927500000) : : ſo Sine of Angle θ c Q (41152,466) : 793213782,15 = Q θ [by the 7th Caſe of right-angled plain Triangles, *Caſwell.*]

6. c ξ = c A = 1927500000. C T = 31877228 [Num. 1.], ſo c F (half the conjugate Axis) = 1927236387,2486 [1ſt *Lemma*]. Then ſay,

Q θ.

Q As

As c ξ (1927500000) : CF (1927236387,249)
Q θ. : : So Q θ (793213782,15) : 793105299 = $\rho\,\theta$ [Sect. 2. *Lemma* 5.]

7. Angle A c Q being = $24^\circ+17'+55''+43'''+55''''$,6 [Num. 5.] = Angle θ c Q, we have Complement 65+42+04+16+04,4 = Angle θ Q C; and we have the Sine of Angle θ Q c = 91141,17944. Then ſay, As Radius (100000) : Sine of θ Q c (91141,17944) : : So
c θ. Q c (1927500000) : 1756746233,706 = c θ [by 7th Caſe of right-angled plain Triangles, *Caſwell*].
T θ. So c T being = 31877228, we have T c + c θ (T θ) = 1788623461,706.

8. Then : As T θ (17886233461,706) : $\rho\,\theta$ (793105299) : : ſo Radius (100000 : 44341,658 + = Tangent of Angle θ T ρ [by the 5th Caſe of right-angled plain Triangles, *Caſwell*]. = Tangent of $23^\circ+54'+47''+51'''+31''''$ = Angle A T ρ.

So from Angle A c N (A T k) 2d Figure

$$=\overset{\circ}{24}+\overset{\prime}{41}+\overset{\prime\prime}{30}+\overset{\prime\prime\prime}{00}+\overset{\prime\prime\prime\prime}{00}\text{[N.1.]}$$

ſubſtracting the Angle A T ρ } = 23+54+47+51+31

Angle k T ρ. we have Remainder = Angle k T ρ,
= 00+46+42+08+29

Equation ♈ T ν. which at preſent I ſhall take for the Equation of the Orbit ♈ T ν.

2d Inſtance. 2d Inſtance : To the mean Anomaly E T ν = $24^\circ+41'+30''$ [1ſt Inſtance], add the Angle ν T g = 4 Sig. + $07'+07^\circ+56''+14'''+24''''$ [2d Proceeding] ; then we have the Sum of theſe two

Mean Anomaly E T g. Angles (the mean Anomaly E T g, 1ſt Figure = 5 Sig. $01^\circ+49'+26''+14'''+24''''$).

1. In 3d Figure draw the Line c N, cutting the Eccentrick in N ſo, as to make the Angle A c N = Angle E T g; and from the lower Focus T, draw T k parallel to c N: So the Angle A T k (Arch A ξ N) = 5 Sig. $+01^\circ+49'+26''+14'''+24''''$. So the Angle B c N (Supplement $= 0+28+10+33+45+36$, and the Sine of this Angle B c N = 47218,2265+). Arch A ξ N. Arch B N.

Draw T ε cutting N c at right Angles in the Point ε. So the Angle T c ε = Angle B c N, ſo the Sine of Angle T c ε = 47218,2265+.

Then ſay, As the Whole Sine (100000) : C T (31877228) : : ſo Sine of Angle T c ε (47218, 2265+) : 15051861,719 — = T ε in Length, and T ε in 4th Scruples $= 5798603'''',72446-$ $= 26'+50''+43'''+23'''',72446-$. T ε''''.

PROOF

For Num. 1.

As Radius C N in Length (1927500000) : T ε in Length (15051861,719—) : : So Radius, C N'''' (742553239'''',43+) : 5798603'''',72446— = T ε''''.

2. In 3d Figure, draw c δ cutting the Arch A ξ N in δ, betwixt N and A, ſo as to make the little Arch N δ = T ε'''' + $= 26'+50''+43'''+23'''',724+$. Then we have the Arch B δ (Arch B N + Arch N δ) $= 28^\circ+37'+24''+28'''+59''''+724+$; and we have the Sine of this Angle B c δ = 47905,135+. Arch N δ. B δ.

Draw T γ cutting c δ at right Angles in the Point γ. The Angle T c γ is given, being = Angle B c δ; ſo the Sine of Angle T c γ = 47905,135+. Then ſay,

As the whole Sine (100000) : c T (31877228) : : So Sine of Angle T c γ (47905,135+) :

15270829,10766 — T γ in Length. And T γ
$T\gamma''''$. in 4th Scruples $= 5882959'''',0779 = 27' + 14''$
$+ 09''' + 19'''',0779 + = T\gamma''''$ [as in the Proof].

PROOF
For Num. 2.

As C N Radius (1927500000) : T γ in Length (15270829,10766—) ſo Radius CN'''' ($742553239'''',43+$) : $5882959'''',0779+ = T\gamma''''$.

Then out of the Arch N μ, $T\gamma''''$
Arch N μ. $= 0 + 00 + 27 + 14 + 09 + 19,1 -$
take the Arch N δ
$= 0 + 00 + 26 + 50 + 43 + 23,7 +$ [Num. 2.]

we have the Remainder = Arch δ μ
Arch δ μ. $- 0 + 00 + 00 + 23 + 25 + 55,2$.

Then by the Reaſoning in 1ſt Inquiry, 2d Proceeding, Num. 3. we find Angle Bc Q > Angle T c ε.

4. Draw Q c, and draw T ♉ cutting Q c at right Angles in the Point ♉; ſo Angle T c ♉ = Angle B c Q.

Then, reaſoning as in 1ſt Inquiry, 2d Proceeding, Num. 4. we have $T♉''''$ > Arch N δ, and Arch N Q = $T♉''''$; ſo Arch N Q > Arch N δ. So Angle B c Q > Angle B c δ.

5. Then, reaſoning as in 1ſt Inquiry, 2d Proceeding, Num. 5. we have Arch N Q > Arch N μ.

And Arch N μ — Arch N δ being = the Affirmative Quantity δ μ [Num. 3.], therefore Arch N μ > Arch N δ.

Conſequently the Point μ is found betwixt the Points δ and Q, in the Arch of the Eccentrick ξ N B.

Then to the Arch B N

$=\overset{\circ}{28}+\overset{\prime}{10}+\overset{\prime\prime}{33}+\overset{\prime\prime\prime}{45}+\overset{\prime\prime\prime\prime}{36}.$ [Num. 1.]

Adding the Arch N μ

$=00+27+14+09+19,1$ [Num. 3.]

and adding to them Arch $\delta\mu$

$=00+00+23+25+55,2$

---

we have the Sum

$=28+38+11+20+50,3-$

which I ſhall take to be nearly = Angle B c Q = Arch B Q.

Angle B c Q.

Arch B Q.

And the Sine of it = 47925,3939+ = Sine of Angle c Q.

Then ſay, As Sine of Angle Q θ c (100000) : Q c (1927500000) : : ſo Sine of Angle θ c Q (47925,3939+) : 923761967,4225 = Q θ [by the 7th Caſe of right-angled plain Triangles, *Caſwell*].

Q θ.

6. c ξ = c A = 1927500000 . c F = 1927236387,249—). [1ſt *Lemma*].

Then ſay, As c ξ (1927500000) : c F (1927236387,249—) : : ſo Q θ (923761967,4225) : 923635629,973+ = $\rho\,\theta$ [Sect. 2. *Lemma* 5.].

$\rho\,\theta$.

7. Angle θ c Q being

$=0$ Sig. $+28^{\circ}+38'+11''+20'''+50'''',3$, [N. 5]

have Angle θ Q c (Complement).

$=2+01+21+48+39+09,7+$

And the Sine of this Angle θ Q c = 87767,795 ; then ſay, As Radius (100000) : Sine of θ Q c (87767,795) : : ſo Radius Q C (1927500000) : 1691724248,695 = c θ [by 7th Caſe of right-angled plain Triangles, *Caſwell*].

C θ.

So c T being = 31877228, [Num. 1.] we have c θ — c T (T θ) = 1659847020,625 = T θ.

8. Then, as T θ (1659847020,625) : $\rho\,\theta$ 923635629,973+) : : ſo Radius (100000) : 55645,

T θ.

55645,8287 + = Tangent of Angle θ T ρ [by the 5th Caſe of right-angled plain Triangles, *Caſwell*]. = Tangent of

Angle B T ρ. $29^{\circ}+05'+38''+48'''+04''''$ = Angle B T ρ,

So the Supplement of this =

A T ρ. 5 Sig. $00^{\circ}+54'+21''+11'''+56''''$ = Angle A T ρ,

Subſtracting this from Angle A c N (Angle A T k)

3d Figure $=5+01+49+26+14+24$ [Num. 1.]

we have the Remainder

Angle k T ρ. $0+00+55+05+02+28$ = Angle k T ρ. = Equation of the Orbit correſponding to the mean Anomaly E T g = 5 Sig. $+01^{\circ}+49'+26''+14'''+24''''$.

So putting the Angle k T ρ here for Equation S T g, and taking the Angle k T ρ in 1ſt Inſtance, Num. 8. above for Equation r T ν, we have Equat. S T g $=55'+05''+02'''+28''''$; and we have Equat. r T ν $=46+42+08+29$, ſo we have

Equation S T g — Equation r T ν

$=08+22+53+59$.

But Equation S T g — Equation r T ν

$=08+12+59+59$ [Sect. 1. N. 11.]

Therefore Equation S T g — r T ν here, is bigger than it ſhould be (is bigger than f) by $9''+54'''+00''''$. Therefore, by the 3d *Lemma*, the mean Anomaly E T ν, in 1ſt Figure, muſt be taken $> 24^{\circ}+41'+30''$, to which the Equation $46'+42''+08'''+29''''$, is correſpondent; and this I ſhall do in the 2d Poſition next following.

Mean Anomaly E T ν. 2d Poſition. 1ſt Inſtance. } Let the mean Anomaly E T ν, in the upper Sector of the Semicircle E a I, in 1ſt Figure $=24^{\circ}+42'+40''$. Let the Eccentricity

c T. c T = 31877228 [as in 1ſt Inquiry, 3d Poſition, Num. 9.].

1. In 2d Figure, draw the Line c N cutting the Eccentrick in N, ſo as to make the Angle A c N = Angle E T ν; and from the lower Focus, T, draw T k parallel to c N. So Angle A c N = Angle A T k = $24^{\circ}+42'+40''$ = Arch A N.

Angle A c N;
A T k.
A N.

Produce N c, and draw T ε cutting N c, produced, at right Angles in ε. The Angle T c ε is given, being = Angle A c N.

And the Sine of Angle T c ε = 41804,33. Then ſay,

As the whole Sine (100000) : c T (31877228) :: So Sine of Angle T c ε (41804,33) : 13326061, 588— = T ε in Length, and T ε in 4th Scruples = $5133753'''',671 = 23'+46''+02'''+33''''$, 671 = $T\varepsilon''''$ (as in the Proof].

$T\varepsilon''''$.

PROOF

For Num. 1.

As Radius C N in Length (1927500000) : T ε in Length (13326061,588—) :: So Radius CN'''' ($742553239''''$,43+) : $5133753''''$,671 = $T\varepsilon''''$.

2. In 2d Figure, draw c δ cutting the Arch A N ξ in δ, betwixt N and A, ſo as to make the little Arch N δ = $T\varepsilon''''$ = $23'+46''+2'''+33''''$,671. Then we have the Arch A δ (Arch A N — Arch N δ) = $24^{\circ}+18'+53''+57'''+26''''$,329 = Angle A c δ.

N δ.
Angle A c δ.

And we have the Sine of Angle A c δ = 411775,279+.

Produce δ C, and draw T γ cutting δ c, produced, at right Angles, in the Point γ. The Angle T c γ is given, being = Angle A c δ, and the Sine of it is given. Then ſay,

As the whole Sine (1000000) : C T (31877228) :: So Sine of Angle T c γ (41175,279+) :

T γ. 13125537,5665 — = T γ in Length. And T γ in 4th Scruples = $5056503'''',47 = -23'+24''+35'''+03'''',47$ [as in Proof].

PROOF

For Num. 2.

As CN in Length (1927500000) : T γ in Length (13125537,5665—) :: So Radius CN'''' (742553239'''',43+) : $5056503'''',47 = T\gamma''''$.

3. Out of the Arch A N, in 2d Figure,

$$=\overset{\circ}{24}+\overset{\prime}{42}+\overset{\prime\prime}{40}+\overset{\prime\prime\prime}{00}+\overset{\prime\prime\prime\prime}{00} \text{ [Num. 1.]}$$

N μ. take the Arch $N\mu = T\gamma''''$

$$=00+23+24+35+03,47$$

A μ. we have Remainder = Arch A μ

$$=24+19+15+24+56,53$$

Then, reaſoning as in 1ſt Inquiry, 1ſt Poſition, Num. 3. we find Angle A c Q < Angle A c N. And Angle A c N being = Angle T c ε, [Num. 1.] therefore Angle A c Q < Angle T c ε.

4. Draw Q c, and draw T ȣ cutting Q c, produced, at right Angles, in the Point ȣ. So Angle T c ȣ = Angle A c Q. And Angle A c Q being < Angle T c ε, [Num. 3.] we have Angle T c ȣ < Angle T c ε.

Angle T c ȣ equal Angle A c Q.

Then, reaſoning as in 2ſt Inquiry, 1ſt Poſition, N. 4. we have T ȣ < Angle T ε, and T ȣ'''' < Arch N δ, and Arch N Q = T ȣ'''', ſo Arch N Q < Arch N δ. Therefore Arch A Q > Arch A δ.

Arch A Q > Arch A δ.

5. Then, reaſoning as in 1ſt Inquiry, 1ſt Poſition, Numb. 5, we have Arch N Q > Arch N μ; ſo Arch A Q < Arch A μ, and Arch A Q > Arch A δ [Num. 4.]: Therefore we find

the Point Q, betwixt the Points δ and μ in the Arch of the Eccentrick A N ξ.

Then having Arch A μ equal to
$24+19+15+24+56,53$ [Numb. 3]
and having Arch A δ equal to
$24+18+53+57+26,33$ [Numb. 2.]

---

we have the Difference equal to
$00+00+21+27+30,20 =$ Arch μ δ. μ δ.
Then to the Arch A δ, adding the Half Difference $= 10''+43'''+45''''$,1. we have the Sum $= 24°19'+04''+41'''+11''''$,43; which I ſhall take to be = Angle A c Q, nearly. And the Sine of it = 41180,02 = Sine of Angle θ c Q. Angle A c Q. θ c Q.
Then ſay,

As Sine of Angle Q θ c (100000) : Q C (1927500000) : : ſo Sine of Angle θ c Q (41180,02) : 793744885,5 = Q θ [by 7th Caſe of right-angled plain Triangles, *Caſwell*]. Q θ.

6. C ξ = C A = 1927500000. C T = 31877228. So c F = 1927236387,2486 [1ſt *Lemma*]. Then ſay, As c ξ (1927500000) : C F (1927236387,2486) : : ſo Q θ (793744885,5) : (793636329,716+ = ρ θ [Sect. 2. *Lemma* 5]. θ,

7. Angle A c Q being $= 24°+19'+04''+41'''+11''''$,43 [Numb. 5.] = Angle θ c Q, we have the Complement $= 65+40+55+18+48,57$ = Angle θ Q c.

And we have the Sine of Angle θ Q c = 91127,982. Then ſay, As Radius (100000) : Sine of θ Q c (91127,982) : : ſo Radius Q c (1927500000) : 1756491853,05 = c θ [by 7th Caſe of right-angled plain Triangles, *Caſwell*]. c θ,

So c T being = 51877228, we have T c + c θ = 1788369081,05 = T θ. T ρ.

8. Then, As T θ (1788369081,05) : ρ θ (793636329,716), ſo Radius (100000) 44377,6588 — = Tangent of Angle θ T ρ [by 5th Caſe

of right-angled plain Triangles, *Caſwell*]. = Tangent of $23^{\circ} + 55' + 49'' + 52''' + 38'''',8 =$ Angle AT ρ.

So from Angle A c N (A T k) 2d Figure

$$= \overset{\circ}{24} + \overset{\prime}{42} + \overset{\prime\prime}{40} + \overset{\prime\prime\prime}{00} + \overset{\prime\prime\prime\prime}{00}$$ [Numb. 1.]

ſubſtracting Angle A T ρ.

$$= 23 + 55 + 49 + 52 + 38,8$$

Angle k T ρ.

we have the Remainder = Angle k T ρ

$$= 00 + 46 + 50 + 07 + 21,2$$

Equat. r T ν.

which at preſent I ſhall take for the Equation of the Orbit r T ν

2d Inſtance.

2d Inſtance: To the mean Anomaly E T ν $= 24^{\circ} + 42' + 40''$ [1ſt Inſtance, Num. 1.] add the Angle ν T g = 4 Sig. $+ 07^{\circ} + 56' + 4''' + 24''$ [1ſt Poſition, 2d Inſtance]; we have the Sum = $5 + 01 + 50 + 36 + 14 + 24$ = the mean Anomaly E T g in the 1ſt Figure.

Mean Anomaly E T g.

1. In the 3d Figure, draw the Line C N cutting the Eccentrick in N, ſo as to make the Angle A c N = Angle E T g; and from the lower Focus, T, draw T k parallel to C N; ſo the Angle A T k = Angle A c N; ſo Angle A c N (Angle A T k, Arch A ξ N) = 5 Sig. $01^{\circ} + 50' + 36'' + 14''' + 24''''$; and ſo Supplement, Angle B c N (Arch B N) = $0 + 28 + 09 + 23 + 45 + 36$.

Angle A T k.
A c N.
Arch A ξ N.

And the Sine of this B c N = 47188,3155+

Draw T ε cutting N c at right Angles in the Point ε. So the Angle T c ε = Angle B c N. So the Sine of the Angle T c ε = 47188,3155+.

Then ſay, As the whole Sine (100000) : c T (31877228) : : ſo Sine of the Angle T c ε (47188, 3155+) : (15042326,92+) = T ε in Length.

T ε.''''

And T ε in 4th Scruples = 5794930'''',523 = $26' + 49'' + 42''' 10''''$,523 [as in the Proof].

PROOF

PROOF

For Num. 1.

As Radius CN (1927500000) : Tε in Length (15042326,2+) : : So Radius CN$''''$ (742553239$''''$,43+) : 5794930,523$''''$ — = Tε''''.

2. In 3d Figure draw cδ cutting the Arch AξN in δ, betwixt N and A, ſo as to make the little Arch Nδ = Tε'''' = $26'+49''+42'''+10''''$,523. Then we have the Arch Bδ (Arch BN + Arch Nδ) = $28^{\circ}+36'+13''+27'''+46''''$,523 — = Angle Bc$\delta$; and we have the Sine of this Angle Bcδ = 47874,92274. Nδ Arch Bδ.

Draw Tγ cutting cδ, at right Angles, in the Point γ. The Angle Tcγ is given, being = Angle Bcδ; ſo the Sine of the Angle Tcγ = 47874,92274.

Then ſay, As the whole Sine (100000) : cT (31877228) : : So Sine of Angle Tcγ (47874,92274] : 15261198,27665+ = Tγ in Length; And Tγ in 4th Scruples = 5879248,88+ = $27'+13''+07'''+28''''$,88 = Tγ'''' [as in the Proof]. Tγ''''.

PROOF

For Num. 2.

As CN Radius (1927500000) : Tγ in Length (15261198,277—) :: So Radius CN$''''$ (742553239$''''$,43+) : 5879248$''''$,88+ = Tγ''''.

Then out of the Arch Nγ = Tμ'''' } = 27+13+07+28,881 Arch Nμ.
take the Arch Nδ = 26+49+42+10,523

we have the Remainder = Arch $\delta\mu$. } = 00+23+25+18,258 Arch $\delta\mu$.

Then by the Reaſoning in 1ſt Inquiry, 2d Proceeding, Num. 3. we find Angle B c Q ⊳ Angle T c δ.

4. Draw Q c, and draw T ♉, cutting Q c at right Angles in the Point ♉. So Angle T c ♉ = Angle B c Q.

Then reaſoning as in 1d Inquiry, 2d Proceeding, Num. 4. we have T ♉'''' ⊳ Arch N δ, and Arch N Q = T ♉''''.

So Arch N Q ⊳ Arch N δ. So Angle B c Q ⊳ Angle B c δ.

5. Then reaſoning as in 1ſt Inquiry, 2d Proceeding, Num. 5. we have Arch N Q ⊳ Arch N μ, and Arch N μ — Arch N δ, being = the Affirmative Quantity δ μ [Num. 3.]. Therefore Arch N μ ⊳ Arch N δ. Conſequently the Point μ is found betwixt the Points δ and Q, in the Arch of the Eccentrick ξ N B.

Then to the Arch B N

$=28^{\circ}+09^{\prime}+23^{\prime\prime}+45^{\prime\prime\prime}+3.6^{\prime\prime\prime\prime}$. [Num. 1.]

adding the Arch N μ

=00+27+13+07.+28,88 [Num. 3.]

And adding to theſe two, Arch δ μ

=00+00+23+25+18,258 [Num. 3.]

---

we have the Sum of the three

=28+37+00+18+23,139

Angle B c Q. which I ſhall take to be nearly = Angle B c Q = Angle θ c Q.

θ c Q. And the Sine of it = 47894,8504 — = Sine of Angle θ c Q. Then ſay, As Sine of Angle Q θ c (100000) : Q C (1927500000) :: ſo Sine of Angle θ c Q (47894,8504) : 923173241,46

Q θ. = Q θ [by 7th Caſe of right-angled plain Triangles, *Caſwell*].

6. e ξ = C A = 1927500000 . C F = 1927236387,2486 [1ſt *Lemma*]. Then ſay, As c ξ (1927500000)

(1927500000) : c F (1927236387,2486) : ; ſo Q θ 923173241,46) : (923046984,527 = ρ θ ρθ.
[Sect. 2. *Lemma* 5.].

7. Angle θ c Q being $=28^{\circ}+37'+00''+18'''+23'''',139$ [Num. 5.], we have Complement (Angle θ Q c) = 61+22+59+41+36,861 ; and we have the Sine of this Angle θ Q c = 877842978+ : Then ſay, as Radius (100000): Sine of θ c Q 17784,2978+) : : ſo Radius Q e (1927500000) : 1692042340,095 = c θ [by cθ.
7th Caſe of right-angled plain Triangles, *Caſwell*]. So c T θ being = 31877228, we have Tθ.
cθ — c T (T) = 1660165112,095 = T .

8. Then as T θ (1660165112,095) : ρ θ (923046984,527) : : ſo Radius (100000) : 55599,7098 = Tangent of Angle θ T ρ [by 5th Caſe of right-angled plain Triangles, *Caſwell*] = Tangent of $29^{\circ}+04'+26''+10'''+22''''$ = Angle B T ρ. And the Supplement of this = Angle B T ρ.
5 Sig. $+00^{\circ}+55'+33''+49'''+38''''$ = Angle A T ρ. This being ſubſtracted from Angle A c N Angle A T ρ.
(from Angle A T k), in 3d Figure, we have the Remainder $=55'+02''+24'''+46''''$ = Angle k T ρ = Equation of the Orbit correſponding to Angle k T ρ.
the mean Anomaly E T g = 5 Sig. $+01^{\circ}+50'+36''+14'''+24''''$ [Num. 1.].

So putting the Angle k T ρ here, for Equation S T g ; and taking the Angle k T ρ, in the 1ſt Inſtance, Num. 8. above, for Equation r T ν,

$$\begin{array}{lcccc} & ' & '' & ''' & '''' \\ \text{we have Equation S T g} = & 55+ & 02+ & 24+ & 46 \\ \text{and we have Equation r T}\gamma = & 46+ & 50+ & 07+ & 21 \end{array}$$

ſo we have Equation S T g } = 8+12+17+25
— Equation r T ν ; but }
Equation ν T g — Equat. r T ν = 8+12+59+59
[Sect. 1. Num. 11.].

Therefore Equation S T g — Equation r T ♈, here, is leſs than it ſhould be (is leſs than f) by 42'''+34''''.

Therefore, by the 3d *Lemma*, the mean Anomaly E T ♈, in 1ſt Figure, muſt be taken leſs than 24°+42'+40'', to give Equation S T g— Equation r T ♈ equal 8'+12''+59'''+59''''.

9. In putting the mean Anomaly E T ♈ = 24°+41'+30'', we have Equation S T g — Equation r T ♈, bigger than it ſhould be by 9''+54''' (by 35640'''') 3d Proceeding, 1ſt Poſition, 2d Inſtance, Num. 8.] : This I call b. b.

And in putting the mean Anomaly E T ♈ = 24°+42'+40'', we have Equation S T g — Equation r T ♈ leſs than it ſhould be by 42'''+34'''' (by 2554'''') 2d Poſition, 2d Inſtance, Num. 8.]. This I call a. a.

Then from 24°+42+'+40'', ſubſtracting 24°41'+30'', we have the Remainder equal to 1'+10''=252000''''. This I call D. D.

Let D be divided into two Parts, ſo as that a proportional Part of it ſhall correſpond to b, which I call x.

So the remaining Part, correſponding to a, will be D—x.

Then ſay, As b : a :: ſo x : D—x ; therefore a x = b D — b x ; ſo a x + b x = b D.

So $x = \frac{b\ D}{a+b}$.

Where b D = 8981280000, and a+b = 38194.

x. So $\frac{8981280000}{38194} = 235149'''' = 1'+05''+19'''+09'''' = x$.

D—x. So 16851''''=4''+40'''+51''''+ = D—x.

Therefore to 24°+41'+30''+00'''+00'''' adding x = 00 + 01 + 05 + 19 + 09, we have the Sum = 24 + 42 + 35 + 19 + 09, for a new E T ♈.

3d Poſition, 1ſt Inſtance, Let the mean Anomaly $ET\nu$, in the upper Sector of the Semicircle $E a I$, in 1ſt Figure, $= 24^\circ + 42' + 35'' + 19''' + 09''''$.

3d Poſition mean Anomaly.

Let the Eccentricity $cT = 31877228$ [as in 1ſt Inquiry, 3d Poſition, Num. 9.].

1. In 2d Figure draw the Line cN cutting the Eccentrick in N, ſo as to make the Angle $AcN =$ Angle $ET\nu$.

Then drawing and calculating as in Num. 1. of 1ſt Poſition, 1ſt Inſtance, we have the Sine of Angle $Tc\varepsilon = 41802,27$; and we have $T\varepsilon = 5133500'''',694 = 23' + 45'' + 58''' + 20'''',694$; and this is $=$ Arch $N\delta$, as in Num. 2.

$T\varepsilon''''$.

$N\delta$.

2. And drawing and calculating as in Num. 2. of 1ſt Poſition, 1ſt Inſtance, we have the Sine of Angle $Tc\gamma = 41173,246$; and we have $T\gamma'''' = 5056253'''',81 - = 23' + 24'' + 30''' + 53'''',81 -$; and this is $=$ Arch $N\mu$, as in Num. 3.

$T\gamma''''$.

$N\mu$.

3, 4, 5. Then drawing and reaſoning as in Num. 3, 4, and 5, of 1ſt Poſition, 1ſt Inſtance, we have Angle AcQ (Angle θcQ) $= 24^\circ + 19' + 00'' + 04''' + 31'''',55$. And the Sine of $\theta cQ = 41177,9833$.

AcQ.
θcQ.

Then calculating as in 1ſt Poſition, 1ſt Inſtance, Num. 5. we have $Q\theta = 792705622,325$.

$Q\theta$.

6. And calculating as in 1ſt Poſition, 1ſt Inſt. Num. 6. we have $\rho\theta = 793597071,911 +$.

$\rho\theta$.

7. And reaſoning and calculating as in 1ſt Poſition, 1ſt Inſtance, 7. we have $c\theta = 1756498734,225$. So cT being $= 31877228$, we have $Tc + c\theta = 1788375962,225 = T\theta$.

$c\theta$.

$T\theta$.

8. Then calculating as in 1ſt Poſition, 1ſt Inſtance, Num. 8. we have the Tangent of Angle $\theta T\rho = 44375,2929 =$ Tangent of $23^\circ + 55' + 45'' + 49''' + 26'''' + =$ Angle $AT\rho$.

So from Angle A c N (A T k) 2d Figure,

$= 24^{\circ} + 42' + 35'' + 19''' + 09''''$ [Num. 1.]

ſubſtracting Angle A T ρ

$= 23 + 55 + 45 + 49 + 26$

Angle k T ρ. we have Remainder Angle k T ρ

$= 00 + 46 + 49 + 29 + 43$

Equation r T ν. which I ſhall take for the Equation of the Orbit r T ν.

2d Inſtance. 2d Inſtance: To the mean Anomaly E T ν.

$= 24 + 42 + 35 + 19 + 09$

add the Angle ν T g

$= 4\ \text{Sig.} + 07 + 07 + 56 + 14 + 24$

[2d Proceeding] we have the Sum of theſe two Angles, the mean Anomaly E T g in 1ſt Figure,

$5 + 01 + 50 + 31 + 33 + 33$

1. In 3d Figure draw the Line c N, cutting the Eccentrick in N, ſo as to make the A c N = Angle E T g.

Then drawing and calculating as in Num. 1. of 1ſt Poſition 2d Inſtance, we have the Sine of Angle T c ε = 47190,31—; and we have T ε'''' = 26′ + 49″ + 46‴ + 15⁗,51—. And this is Arch N δ, as in Num. 2.

T ε.''''. N δ.

2. And drawing and calculating, as in Num. 2. of 1ſt Poſition, 2d Inſtance, we have the Sine of Angle T c γ = 47876,939. And we have T γ'''' = 27′ + 13″ + 11‴ + 36⁗,484. And this = Arch N μ, as in Num. 3.

T γ''''. N μ.

3, 4, 5. Then drawing and reaſoning as in Numbers 3, 4, and 5, of 1ſt Poſition, 2d Inſtance, we have Angle A c Q (Angle θ c Q) — = $28^{\circ} + 37' + 05'' + 03''' + 27''''$,5. And the Sine of this Angle θ c Q = 47896,8745+. Then calculating as in 1ſt Poſition, 2d Inſtance, Num. 5. we have Q θ = 923212255,9875.

A c Q. Q θ.

6. And calculating as in 1ſt Poſition, 2d Inſtance, Num. 6. we have $p\theta = 923085993{,}7188$. $p\theta$.

7. And reaſoning and calculating as in 1ſt Poſition, 2d Inſtance, Num. 7. we have $c\theta$ equal to $1692021075{,}915$; ſo c T being equal to 31877228, we have $c\theta - cT$ ($T\theta$) equal to $1660143847{,}915$. $c\theta$. $T\theta$.

8. Then calculating as in 1ſt Poſition, 2d Inſtance, Num. 8. we have the Tangent of Angle $\theta T p = 55602{,}7717 =$ Tangent of $29^\circ + 04' + 30'' + 58''' + 46'''' =$ Angle BTp. Angle BTp.

And the Supplement of this

Sig. ° ′ ″ ‴ ⁗

$= 5 + 00 + 55 + 29 + 01 + 14 =$ Angle ATp.

So from Angle AcN (ATk) in 3d Figure

$= 5 + 01 + 50 + 31 + 33 + 33$ [Num. 1.]

Subſtracting Angle ATp

$= 5 + 00 + 55 + 29 + 01 + 14$,

we have the Remainder = Angle kTp Angle kTp.

$= 0 + 00 + 55 + 02 + 32 + 19$

So putting the Angle kTp here, for Equation STg, we have Equation STg

′ ″ ‴ ⁗

$= 55 + 02 + 32 + 19$, and we have Equation $rT\nu$

$= 46 + 49 + 29 + 43$ [1ſt Inſtance, Num. 8.]

So Equation STg — Equation $rT\nu$

$= 8 + 13 + 02 + 36$; but Equat. STg — Equa.: $rT\nu$

$= 8 + 12 + 59' + 59$ [Sect. 1. Num. 11.]

therefore Equation STg — Equation $rT\nu$ here, is > than it ſhould be by $0 + 00 + 02''' + 37''''$.

Therefore, by the 3d *Lemma*, the mean Anomaly $ET\nu$, in 1ſt Figure, ſhould be taken more than $24^\circ + 42' + 35'' + 19''' + 09''''$.

But the Difference betwixt Equation STg — Equation $rT\nu$ here, and Equation STg — $rT\nu$, in Sect. 1. Num. 11. being ſo ſmall as $2''' + 37''''$, I ſhall take the Line of Apſes to cut the elliptical Arch n δ, in 1ſt Figure, ſo as to give the mean Anomaly E T ν $= 24^{\circ}+42'+35''+19'''+09''''$, to which the Equation of the Orbit correſponding $= 46'+49''+29'''+43''''$ = Equation r T ν.

And ſubſtracting this Equation r T ν, from the mean Anomaly E T ν, we have the Remainder $= 23^{\circ}+55'+45''+49'''+26''''$ = the true Anomaly A T δ.

True Anomaly A T δ.

4th Proceeding.

1. At Noon, at *Greenwich*, on *July* 14th *(O. S.)*, in the *Julian* Year of Chriſt 1711, the Sun, according to its apparent Motion, was under $1^{\circ}=27'+49''+40'''+14''''$ of ♌, and at the Point δ of its Orbit, in 1ſt Figure [Sect. 1. Num. 13.].

Let the mean Anomaly at that Moment, the Angle E T ν $=24^{\circ}=42'=35''=19'''=09''''$, the Equation of the Orbit, the Angle r T ν being then $= 46'+49''+29'''+43''''$, and the true Anomaly, the Angle A T δ, being $=23''+55'+45''+49'''+26''''$ [3d Proceeding, 3d Poſition, 2d Inſtance, Num. 8.].

Apogæum of the Sun's Orbit.

Then ſubſtracting the Angle A T δ from $1^{\circ}+47'+29''+40'''+14''''$ of ♌, we have the Remainder $=7^{\circ}+51'+43''+50'''+48''''$ of ♋, for the Point of the Ecliptick under which the *Apogæum* of the Sun's Orbit was at the Noon, at *Greenwich*, on the ſaid *July* 14th, in the ſaid Year 1711.

So at that Moment the *Perigæum* of the Sun's Orbit, B, was under $7^{\circ}+51'+43''+50'''+48''''$ of ♑.

Sun's Middle Motion under the Ecliptick.

2. Then to $1^{\circ}+47'+29''+40'''+14''''$ of ♌, adding the Equation of the Orbit r T ν equal to $46'+49''+29'''+43''''$, we have the Sum equal to $2^{\circ}+34'+19''+09'''+57''''$ of ♌, for the Point of the Sun's middle Motion under the Ecliptick

at Noon, at *Greenwich* on the 14th Day of *July* in the ſaid Year 1711.

3. In the Space of 129 apparent Days forwards, from Noon, at *Greenwich*, on the ſaid 14th aſtronomical Day of *July*; in which Space of apparent Time, were contained no more than 128 Days, + 23 Hours, + 43 Minutes, + 32 Seconds, + 05 Thirds, + 08 Fourths of equal Time, the Sun's Middle Motion in its Orbit, (the Angle ♈ T g, in 1ſt Figure) was equal to 4 Sig. $+07^{\circ}+07'+56''+14'''+24''''$ [Sect. 1. Num. 11.]. And adding hereto the Angle ET♈ $=24^{\circ}+42'+35''+19'''+09''''$, [Num. 1.] we have the Sum = the mean Anomaly E T g = 5 Sig. $+01^{\circ}+50'+31'+33''+33'''$; from which ſubſtracting the Equation of the Orbit S T g $=55'+02''+32'''+19''''$ [3d Proceeding, 2d Inſtance, Num. 8.] we have the Remainder = 5 Sig. $+00^{\circ}+55'+29''+01'''+52''''$ for the true Anomaly A T ♈.

True Anomaly A T ♈.

And adding the Motion of the Sun's *Apogæum* in thoſe 128 Days, + 23 Hours, + 43 Minutes, + 32 Seconds, + 05 Thirds, + 04 Fourths of equal Time; namely, adding $17''+39'''+01''''$ [Sect. 1. Num. 1.] to the Place of the Sun's *Apogæum* at Noon, at *Greenwich*, on the ſaid 14th Day of *July*, we have the Place of the Sun's *Apogæum*, at the End of thoſe 129 apparent Days, under $7^{\circ}+52+01''+29'''+49''''$ of ♋.

To which adding the true Anomaly A T ♈ 5 Sig. $+00^{\circ}+55'+29''+01'''+52''''$, we have the Sum = 5 Sig. $+08^{\circ}+47'+30'+31''+41'''$, which was the Diſtance from the Beginning of the Sign ♋ of the Eclipticк of the Point under which the Sun was, according to apparent Motion, at Noon, at *Greenwich*, on the 20th Day of *November (O. S.)*, in the *Julian* Year of Chriſt 1511.

So at that Moment of Time, the Sun, according to its apparent Motion, was under $8^{\circ}+47'+30''+31''+41'''$ of ♐.

This is leſs than the Sun's apparent Place found by my Calculations, from Mr. *Flamſteed's* Obſervations at the ſaid Noon, on the ſaid 20th of *November*; but the Deficiency is no more than $2'''+09''''$, as may be ſeen above [in Chap. IV. Sect. 5. Num. 3.].

4. Then to $8^{\circ}+47+'30''+31'''+41''''$ of ♐, adding the Equation of the Orbit S T g $=55'+22''+32'''+19''''$ [Num. 3.], we have the Sum $=9^{\circ}+42'+33''+04'''+00''''$ of ♐, for the Point of the Sun's Middle Motion under the Ecliptick at Noon, at *Greenwich*, on the ſaid 20th of *November*, in the *Julian* Year of Chriſt 1711.

COROLLARY.

Corollary.

Hence, (and from Num. 2.) in the Sun's Deſcent from the *Apogæum* to the *Perigæum*, the Sun's apparent Motion + Equation of the Orbit correſponding = Sun's Middle Motion under the Ecliptick.

5. At Noon at *Greenwich*, at the Beginning of the 30th aſtronomical Day of *January*, *(Old Stile)*, in the *Julian* Year of Chriſt 1711, the Sun was at the Point ♏ of its Orbit, in 1ſt Figure, according to apparent Motion; and, at the ſame Moment, the Body was at the Point h of the Circle [Sect. 1. Num. 9.].

Then in the Space of 177 apparent Days forwards, from that Noon; in which Space of Time, were contained no more than 116 Days + 23 Hours, + 43 Minutes, + 30 Seconds, + 40 Thirds, + 04 Fourths of equal Time, the Sun's

Middle Motion in its Orbit (the Angle h T o, in 1ſt Figure) was $= 3$ Sig. $+25^{\circ}+18'+17''+52'''+26''''$ [Sect. 1. Num. 9.].

Then, in the Space of 48 apparent Days, farther forwards from that Noon at *Greenwich*, on the ſaid 30th of *January*, in the ſaid Year 1711; in which Space of apparent Time, were contained 48 Days, + 07 Minutes, + 52 Seconds, + 42 Thirds, + 47 Fourths of equal Time, the Sun's Middle Motion in its Orbit in thoſe 48 apparent Days was $= 1$ Sig. $+17^{\circ}+18'+52''+38'''+42'''' =$ Angle o T ♈ in 1ſt Figure [Sect. 1. Num. 10.].

So in thoſe 165 apparent Days, in which Space of Time were contained no more than 164 Days + 23 Hours, + 51 Minutes, + 23 Seconds, + 22 Thirds, + 51 Fourths of equal Time; and the Sun's Middle Motions in its Orbit in thoſe Spaces of equal Time, were 5 Sig. $+12^{\circ}+37'+10''+31'''+08''''$.

Then the Motion of the *Apogæum* in thoſe 117 apparent Days, was $16''+00'''+30''''$; and the Motion of the *Apogæum* in thoſe 48 apparent Days, was $6''+34'''+09''''$ [Sect. 1. Numbers 9 and 10.]; ſo the Sum of the Motions of the *Apogæum* in thoſe two Intervals of Time $= 22''+34'''+39''''$. So from the Place of the Sun's *Apogæum* at Noon at *Greenwich*, in the ſaid 14th of *July*; *viz.*

$\quad\quad\quad {}^{\circ} \quad {}' \quad {}'' \quad {}''' \quad {}''''$

From 7+51+43+50+48 of ♋ [Num. 1.]
ſubſtracting 0+00+22+34+39
we have the ——————————————
Remainder 7+51+21−16+09 of ♋, for the Place of the Sun's *Apogæum* at Noon at *Greenwich*, on the Beginning of the 30th aſtronomical Day of *January* (*Old Stile*), in the ſaid Year 1711.

Place of the Sun's *Apogæum*.

So that at that Moment the *Perigæum* of the Sun's Orbit B was under $7^{\circ}+51'+21''+16'''+09''''$ of ♑.

Then the mean Anomaly E T g equal to
Sig. ° ′ ″ ‴ ⁗
5+01+50+31+33+33 [Num. 11.],
Angle g T I. ſo Angle g T I (Supplement) equal to
0+28+09+28+26+27 ; which Angle
the Sun paſſed through by the Middle Motion in
By my Tables, its Orbit, in 28 Days, +13 Hours, +39 Minutes, +24 Sec. + 51 Thir. +58 Fourt. of equal Time.

Angle I T h. Then Angle I T h being equal to
Sig. ° ′ ″ ‴ ⁗
2+10+14+53+14+28 [S. 1. n. 12.] ſubſtract.
0+28+09+28+26+27 = Angle g T I,
——————————— we have the Remainder
1+12+05+24+48+01 = Angle I T h:
So the Sun's mean Anomaly at Noon at *Greenwich*, on the ſaid 30th of *January*, in the *Julian* Year of Chriſt 1711, was = 7 Sig. + $12^{\circ}+05'+24''+48'''+01''''$.

Then the true Anomaly A T ♈ being equal to
Sig. ° ′ ″ ‴ ⁗
5+00+55+29+01+52 [Num. 3.]
♈ T B. we have the Supplement ♈ T B equal to
0+29+04+30+58+08 ;
and Angle ♈ T m being equal to
B T m. 2+12+24+05+40+00, [Sect. 1. Num. 12.]
ſubſtracting Angle ♈ T B, we have the Angle B T m
= 1+13+19+34+41+52 ;
adding hereto the Diſtance of the Point B, Eaſtward from the Beginning of ♑ equal to
0+07+51+21+16+09, we have the Sum ♑ T m
———————————
= 1+21+10+55+58+01 ; ſo we have Point
Sun's apparent Motion under the Ecliptick. m of the Orbit under 21+10+55+58+01 of ♒ for the Place of the Sun's apparent Motion under the Ecliptick at Noon at *Greenwich*, at the Beginning

ginning of the ſaid 30th Day of *January*, in the *Julian* Year of Chriſt — 1711.

This is leſs than the Sun's apparent Place found by my Calculations from Mr. *Flamſteed*'s Obſervations at the ſaid Noon, on the ſaid 30th of *January*; but the Deficiency is no more than $1'''+59''''$, as may be ſeen above, [Chap. IV. Sect. 2. Num. 3.].

6. Then from Angle B T m =

$$\begin{array}{l}
\text{Sig}\quad {}^{\circ}\quad {}'\quad {}''\quad {}'''\quad {}'''' \\
1+13+19+34+41+52 \ \text{[Num.5.]}
\end{array}$$

ſubſtracting $1+12+05+24+48+01$

I T h ——————— we have the

Remaind. $=0+01+14+09+53+51$ = Angle h T u = the Equation of the Orbit correſponding to the mean Anomaly 6 Signs + Angle I T h.

Angle h T u, the Equation of the Orbit.

Subſtracting this Equation of the Orbit from $21^{\circ}+10'+55''+58'''+01''''$ of ♒, we have the Remainder $= 19^{\circ}+56'+46''+04'''+10''''$ of ♒, for the Point of the Sun's Middle Motion under the Eliptick, at Noon at *Greenwich*, on the ſaid 30th Day of *January*.

7. At Noon at *Greenwich*, at the Beginning of the 30th aſtronomical Day of *January (Old Stile)*, in the ſaid Year of Chriſt 1711, the Sun was at the Point ♏ of its Orbit, under $21^{\circ}+10'+55''+58'''+01''''$ of ♒, according to its apparent Motion; but under $19^{\circ}+56'+46''+04'''+10''''$ of ♒, according to the Middle Motion [Num. 5 and 6.].

And the Place of the Sun's *Apogæum* at that Noon, was $7^{\circ}+51'+21''+16'''+09''''$ of ♋, [Num. 5.].

Then in the Space of 117 apparent Days forwards, from the ſaid Noon, on the ſaid 30th of *January*; in which Space of Time were contained no more than 116 Days, + 23 Hours, + 43 Minutes, + 30 Seconds, + 40 Thirds, + 4 Fourths

Sun's Middle Motion under the Eliptick.

of equal Time, the Sun's Middle Motion in its Orbit, during that Interval of equal Time (the Angle h T o in 1ſt Figure), being = 3 Sig. + $25^{\circ}+18'+17''+32'''+26''''$.

And in this Space of equal Time, the Sun's *Apogæum* moved eaſtward, under the Ecliptick, $16''+00'''+30''''$, [Num. 5.]; ſo to the Place of the Sun's *Apogæum* at Noon at *Greenwich*, on the ſaid 30th of *January*, ſo

$$\begin{array}{rr} & {}^{\circ}\quad '\quad ''\quad '''\quad '''' \\ & 7+51+21+16+09 \text{ of } ♋ \\ \text{[Num. 5.] adding} = & 0+00+16+00+30 \\ \hline \end{array}$$

we have the Sum $7+51+37+16+39$ of ♋ for

Place of the Sun's Apogæum.

the Place of the Sun's *Apogæum* under the Ecliptick at Noon at *Greenwich*, at the Beginning of the 27 aſtronomical Day of *May (Old Stile)* in the *Julian* Year of Chriſt 1711.

Then Angle B T ♏ being

$$\begin{array}{ll} \text{Sig.}\quad {}^{\circ}\quad '\quad ''\quad '''\quad '''' & \\ =1+13+19+34+41+52 & \text{[Num. 5.]} \end{array}$$

and Angle m T n being

$$\begin{array}{ll} =3+24+47+11+32+57 & \text{[Sect. 1. Num. 9.]} \\ \hline \end{array}$$

we have the Sum of theſe

Angle B T n.

$=5+08+06+46+14+49 =$ Angle B T n.

Subſtracting this from 6 Sig. we have the Remain.

Angle n T A.

$=0+21+53+13+45+11 =$ Angle n T A.

Subſtracting this Angle n T A from the Place of the Sun's *Apogæum* at the Beginning of the ſaid aſtronomical 27th Day of *May*; *viz.* from $7^{\circ}+51'+37''+16'''+32''''$ of ♋, or from $37^{\circ}+51'+37''+16'''+39''''$ of ♊, we have the Remainder $= 15+58+23+31+28$ of ♊ for the

Sun's apparent Place under the Ecliptick.

Point of the Ecliptick, under which the Sun was at n, according to its apparent Motion, at Noon, at *Greenwich*, at the Beginning of the ſaid 27th Day of *May*, in the ſaid Year 1711.

This is leſs than the Sun's apparent Place found by my Calculations from Mr. *Flamſteed's* Obſervations at the ſaid Noon, on the ſaid 27th of *May*; but the Deficiency is no more than $1'''+59''''$, as may be ſeen above [Chap. 4. Sect. 3. Num. 3.].

8. Angle I T h being
Sig. ° ' '' ''' ''''
=1+12+05+24+48+01 [Num. 5.]
and Angle h T o being
=3+25+18+17+52+26 [Sect. 1. Num. 9.]
we have the Sum
=5+07+23+42+40+27 = Angle I T o.

Angle I T o.

Subſtracting this from Angle B T n, above, we have the Remainder $= 43'+03''+34'''+22''''$ for the Angle o T n (o T σ); which is the Equation of the Orbit, to be added to the mean Anomaly 6 Sig. + Angle I T o, to give the true Anomaly 6 Signs + Angle B T n.

Equation of Orbit o T σ.

Then from the Sun's apparent Place under the Ecliptick, at Noon on the ſaid 27th of *May*,
° ' '' ''' ''''
from [Num. 7.] =15+58+23+31+28=of
ſubſtracting the Equation o Tσ } =00+43+03+34+22
we have the Remainder =15+15+19+57+06 for the Sun's middle Motion under the Ecliptick at Noon at *Greenwich*, on the ſaid 27th Day of *May*, in the ſaid Year 1711.

Sun's middle Motion under the Ecliptick.

° ' '' ''' ''''
And from Equation h T u = } 1+14+09+53+51 [Num. 6.]
ſubſtracting Equation oTσ = } 0+43+03+34+22
Equation h T u -- Equat. oTσ = } 0+31+06+19+29

This exactly agres with that Difference ſet forth above, in Sect. 1. Num. 9.

So finding ſuch Agreements with my Calculations from Mr. *Flamſteed*'s Obſervations ſet forth above, [in Chap. 4. Sections 2, 3, 4, and 5.] and alſo with my Determinations of the Intervals of equal Time contained in the Spaces betwixt the Times of Obſervation; I ſhall proceed in my Purpoſe, by taking the Eccentricity of the Sun's Orbit, c T, = 31877228, as accommodated to the Semi-axis C A = 1927500000.

COROLLARY.

Corollary. Hence, and from Number 6. in the Sun's Aſcent from the *Perigæum* to the *Apogæum*, the Sun's apparent Motion under the Eclipticks —, the Equation of the Orbit = the Sun's middle Motion under the Ecliptick.

SECT. IV.

4th Section. THE Advantage of having a Table of the Equations of the Sun's Ecliptick Orbit, ſuited to their reſpective mean Anomalies, at hand, is, in ſome meaſure, apparent by the Uſes thoſe Equations have been applied to in the ſeveral Poſitions throughout the 3d Section of this Chapter; and will be yet more apparent by the Uſes they will be applied to in the 6th Chapter below: Therefore I have compoſed ſuch a Table.

As to my Method of compoſing that Table, I found, that putting half the tranſverſe Axis A c = 1927500000 (in the Figures for Sect. 3.) and putting the Eccentricity of c T = 31877228, and calculating according to the Form of Sect. 3, 1ſt Inquiry, 1ſt Poſition, there are ſuch Agreements with my Calculations from Mr.

Flamſteed's Obſervations ſet forth in Chap. 4. Sections 2, 3, 4, and 5, and alſo ſuch Agreements with my Determinations of the Intervals of equal Time, contained in the Spaces of Time betwixt thoſe Obſervations, that I conclude the Eccentricity = 31877228. is well accommodated to the Semi-axis 1927500000 to ſerve for aſtronomical Purpoſes [Sect. 3. 4th Proceeding, Num. 8.].

And I found, that the mean Anomaly, Angle ET κ, in Firſt Figure for Sect. 3. being put $=91^\circ+11'+10''+29'''+30''''+$, the Equation of the Orbit correſponding would be $1^\circ 53'+49''+04'''+19'''$; and that this Equation of the Orbit is the greateſt which can be found throughout the Semicircle E a I; and that the bigger the mean Anomaly is, provided it doth not exceed $91^\circ+11'+10''+29'''+30''''+$, the bigger we have the Equation of the Orbit correſponding; but that the bigger the mean Anomaly is, exceeds $91^\circ+11'+10''+29'''+30''''+$, the leſs we have the Equation of the Orbit correſponding; as may ſeverally appear by what have been ſaid above [Sect. 3. 1ſt Inquiry, 2d *Lemma*, Num. 9. and from the Corollary ſubjoined].

The Method of making the Table of the Equations of the Sun's elliptical Orbit.

So putting the Eccentricity c T = 31877228, and taking the mean Anomaly E T ν orderly = 1, 2°, 3°, and ſo on, throughout the upper Sector of the Semicircle E a I; *viz.* to 91° incluſive; and working with each of thoſe Degrees according to the Eight Operations in Sect. 3. 3d Proceeding, 1ſt Poſition, 1ſt Inſtance; we have the Equations of the Sun's elliptical Orbit correſponding to each Degree of mean Anomaly reſpectively throughout that upper Sector.

Again, putting the Eccentricity c T = 31877228, and taking the mean Anomaly ETg = 92°, 93°, 94°, and ſo on, orderly, throughout the

the

the lower Sector κ T I, and working with each of theſe Degrees according to the Form of the Eight Operations in Sect. 3. 3d Proceeding, 1ſt Poſition, 2d Inſtance, we have the Equations of the Sun's elliptical Orbit correſponding to each Degree of mean Anomaly reſpectively throughout that lower Sector.

Thus having the Equations of the Orbit correſponding to each Degree of the Semicircle E a I, in 1ſt Figure, we have, at the ſame, the Equations of the Orbit correſponding to each Degree of mean Anomaly throughout the Semicircle I b E, in the 1ſt Figure.

For the Angle A T δ being = Angle nTA, in 1ſt Figure, we have the Equation correſponding to Angle A T δ = Equation correſponding to Angle n T A. And the Angle γ T B being = Angle B T m, in 1ſt Figure, we have the Equation correſponding to Angle γ T B = Equation correſponding to Angle B T m [Sect. 2. Lemma 1.]; therefore the Equation correſponding to the mean Anomaly $180^\circ - x^\circ$ = Equation correſponding to the mean Anomaly $180^\circ + x^\circ$.

Conſequently the Equations of the Orbit correſponding to each Degree of mean Anomaly throughout the Semicircle I b E are given, when the Equations correſponding to each Degree of mean Anomaly throughout the Semicircle E a I are found.

Theſe Equtions, ſuited to their correſponding mean Anomalies, I have ſet down in a Table, amongſt the Tables at the End of this Volume, under the Title: *A Table of the Equations*; *or*, Proſtaphæreſes *of the Sun's elliptical Orbit*.

SECT. V.

5th Section. FOR the ſake of expeditiouſly ſuiting the Sun's right Aſcenſions to their correſponding Points of the Ecliptick, under which the Sun may be according to its apparent Motion at any Moment of Time required, it will be neceſſary to have a Table at hand of the Sun's right Aſcenſion accommodated to each Degree of the Ecliptick.

Therefore I have compoſed ſuch a Table, and have put it amongſt the Tables, at the End of this Second Volume; and, in ſome Examples, ſet forth below [in Chap. 6.] I have ſhewn the Uſes of that Table.

And, for the Satisfaction of my Readers, I have here-under ſubjoined the Principles, and the Method upon which I proceeded in filling my Table of the Sun's right Aſcenſions.

1. In the Figure for Sect. 5. let the Arch ♈ A α H ♎, be a Semicircle of the Equinoctial Circle, and let the Arch ♈ P ♋, y ♎, be a Semicircle of the Ecliptick, theſe Two Semicircles interſecting each other in the Equinoctial Points, ♈ A α, and ♈ P ♋ being Quadrants of thoſe Circles reſpectively.

Let the Line D ♋ α repreſent a Quadrant of a great Circle proceeding from D, which is the North Pole of the Equinoctial.

Let the Arches D A and D H be Quadrants of a great Circle proceeding from D likewiſe, and cutting the Quadrant ♈ P ♋, and ♋ y ♎ in P and y reſpectively.

So the Triangle ♈ A P is a ſpherical Triangle right-angled at A, ♈ P is the Hypothenuſe, ♈ A is to be taken for the Baſis, and A P is Perpendicular to it.

So the Baſis ♈ A is the right Aſcenſion of the Point P of the Ecliptick [Sect. 1. Num. 2.].

Alſo the Triangle ♎ H y is a ſpherical Triangle right-angled at H, ♎ y is the Hypothenuſe, ♎ H is to be taken for the Baſis, and H y is perpendicular to it.

So the Quadrant ♈ A α + Arch α H, is the right Aſcenſion of the Point y of the Ecliptick.

The Angle A ♈ P (α ♈ ♋) = the greateſt Declination of the Ecliptick = 23°+28′=54′ Arch α ♋ (Chap. 3. Num. 13.) and Num. 13. of the Affections of ſpherick Triangles [*Caſwell*] ſo the Arch ♋ D (Complement)=66°+31′+06.

2. Let the Hypothenuſe ♈ P be given, or aſſumed; and let it be required to aſſign the right Aſcenſion of the Point P of the Ecliptick.

Having the Arch ♋ D = 66°+31′+6″, [Num. 1.] we have the Sine of it (the Coſine of the Angle α ♈ ♋) =91718,7622; and we have the Sine of the Quadrant D ♋ α = 100000. And the Triangle D P ♋, is a ſpherical Triangle right-angled at ♋. So the Arch ♋ P is perpendicular to the Baſis D ♋. And having the Hypothenuſe ♈ P given, or aſſumed, we have the Complement for the perpendicular ♋ P. So we have the Tangent of the Parpendicular ♋ P; which I call t.

Then ſay, As the Sine of the Arch ♋ D, *ſc.* as the Coſine of the Angle A ♈ P (91718,7622): to the Sine of the Quadrant α ♋ D (100000): ſo is the Tangent of the Perpendicular ♋ P (t):

$$\left.\frac{100000\ t}{91718,7622}\right\}$$

Sc. to the Tangent of the Perpendicular α A [by the ſecond Axiom of ſpherick Trigonometry].

Then having the Perpendicular α A, and ſubſtracting it out of the Quadrant ♈ A α, we have the Remainder ♈ A for the Baſis of the right-angled ſpherick Triangle ♈ A P, which is the right Aſcenſion of the Point P of the Ecliptick.

So putting for Example:

As the Coſine of the Arch α♋ (91718,7622) :	Of 31° (60086,06) : 65511, 1981 + = Tangent of 33°=13′+45″+27‴+58⁗ = A; ſo Complement of α A (♈ A) = 56° + 46′ + 14″+32‴+02⁗ = right Aſcenſion of Complement of ♋ P, *viz.* of 59°, or of 29° of ♉
To the Sine of the quadrantal Arch α ♋ D (100000) : : So the Tangent of the Perpendicular ♋ P.	Of 30° (57735,0272-) : 62947-:8918+=Tangent of 32°+11′+22″+22‴+51⁗=αA; ſo Complement of α A (♈ A) =57°+48′+37″+37‴+09⁗ = right Aſcenſion of Complement of ♋ P ; *viz,* of 60°, or of 30° of ♉.

So putting ♋ P orderly = 89°, 88, and ſo on, we ſhall orderly have the Arch α A, and ſo the Complement ♈ A for the right Aſcenſion of the Complement of ♋ P ; namely, for the right Aſcenſion of 1°, 2°, and ſo on, of the Eclipticк, in Order, the right Aſcenſion of the Quadrant ♈ P ♋, being the Quadrant ♈ A α, or 90, or Three Signs.

3. The Arch α H ♎ is a quadrantal Arch of the Equinoctial Circle, being the Continuation of the quadrantal Arch ♈ A α to a Semicircle.

And the Arch ♋ y ♎, is a quadrantal Arch of the Ecliptick Circle, being the Continuation of the quadrantal Arch ♈ P ♋ to a Semicircle.

And the Triangle D y ♋ is a ſpherical Triangle right-angled at ♋. So the Arch ♋ y is perpendicular to the Baſis D ♋, Let the Perpendicular ♋ y = Perpendicular ♋ P. So the Perpendicular α H = Perpendicular α A, being $=\frac{100000\ t}{91718{,}7622}$ [by the Reaſoning above, in N. 2.]

So we have the Arch of the Ecliptick ♈ ♋ y $=90^\circ+$ Arch ♋ P. And we have the Arch of the Equinoctial ♈ α H $=90^\circ+$ Arch α A.

For filling the Places betwixt 30 Deg. ♊ and 1ſt of ♒.

Then for filling the Places of the Table with the right Aſcenſions correſponding to the ſeveral Degrees of the Ecliptick, betwixt the 30th Degree of ♊, and the 1ſt Degree of ♎;

Having the Arches ♋ P and α A, [by Num. 2.] by adding the Arch ♋ P to 90°, we have Sum = the Arch of the Ecliptick ♈ ♋ y.

And by adding the Arch α A to 90°, we have the Sum = the Arch of the Equinoctial ♈ α H, which is the right Aſcenſion of the Arch of the Ecliptick ♈ ♋ y.

To apply this to the Examples above:

♋ P being put $=31^\circ$,, we have the Arch α A $=33^\circ+13'+45''+27'''+58''''$, as in the 1ſt Example above.

And adding this ♋ P to 90°, we have the Sum $=121^\circ=$ Arch ♈ ♋ y, ſo y under 1° of ♌.

And adding this α A to 90°, we have the Sum $=123^\circ+13'+45''+27'''+58'''$, for the right Aſcenſion of 1° of ♌.

After this manner, proceeding orderly throughout the Quadrant ♋ y ♎, we have the Places of the Table filled with the right Aſcenſion, correſpondent to each Degree of the Quadrant ♋ y ♎; and we have the right Aſcenſion of the Semicircle ♈ ♋ ♎ of the Ecliptick = the Semicircle ♈ α ♎ of the Equinoctial $=180^\circ$.

4. Then for filling the Places of the Table with the right Aſcenſions correſponding to the ſeveral Degrees of the Ecliptick throughout the Semicircle ♎ ♑ ♈.

To the right Aſcenſion correſponding to each Degree of the Sine ♈, adding orderly, 180, we have orderly the Places of the Table filled with right Aſcenſions correſponding to each Degree of the Sign ♎; and to the right Aſcenſions correſponding to each Degree of the Sine ♉, adding orderly 180°, we have orderly the Places of the Table filled with the right Aſcenſions correſponding to each Degree of the Sine ♏; and ſo on throughout the Semicircle ♎ ♑ ♈.

For in 1ſt Figure for Chap. V. Sect. 1. the Angle ♑ ♎ *a* being = Angle ♋ ♈ *a* in ſecond Figure, we have the Declinations of the ſeveral Points of the Quadrant ♎ ♏ ♐ ♑ = the Declinations of the ſeveral Points of the Quadrant ♈ ♉ ♊ ♋ reſpectively.

For like Reaſon, the Declination of the ſeveral Points of the Quadrant ♑ ♒ ♓ ♈, are = the Declinations of the ſeveral Points of the Quadrant ♋ ♌ n 8 ♎, as is obvious. Therefore, adding orderly 180° to each Degree of the Semicircle ♈ ♋ ♎, we have, orderly, the right Aſcenſion of each Degree of the Semicircle ♎ ♑ ♈.

SECT. VI.

Sect. 6. being an Appendix to Chap. I. Sect. 6. Num. 5. *&c.*

MR. *Flamſteed* having determined, that the Sun's biggeſt apparent Diameter was to its leaſt apparent Diameter, as 1965 to 1890 [as above, Chap. I. Sect. 6. Num. 5.], from that Determination, putting T A (in 1 Figure, for Chap. V. Sect. 2.) = 1965000000, and ſo having T B = 1890000000, and ſo having half the tranſverſe Axis c A = 1927500000, and the Eccentricity c T = 37500000, I made ſome Calculations by theſe Proportions.

But when, to the mean Anomalies given, or aſſumed, I came to adapt the Equation of the Sun's elliptical Orbit ariſing by theſe Calculations, I found that the Eccentricity c T muſt be leſs, conſiderably, than 37500000; and by orderly putting ſeveral Quantities for the Eccentricity, and calculating thereupon, I found, at length, that 31877228 would agreeably ſtand for the Eccentricity in proportion to the Semi-axis 1927500000 [Sect. 3. 1ſt Inquiry, 3d Poſition, Num. 9.].

Withal, conſidering the Uncertainty there muſt be in nicely adjuſting the Proportion of the Sun's biggeſt apparent Diameter to its leaſt apparent Diameter, by ſuch Obſervations as Mr. *Flamſteed* made uſe of, I at firſt readily embraced this new Determination of the Eccentricity, as well knowing, that no Quantity could be admitted for it, which did not anſwer in calculating thereby.

Then, finding in my Proceedings throughout the reſt of my third Section, ſuch Agreements with my Calculations hereupon from Mr. *Flamſteed*'s Obſervations ſet forth in Chap. IV. Sect. 2. 3. 4. and 5. I was confirmed in my Opinion, that 31877228 muſt be taken for the Eccentricity c T accommodated to the Semi-axis = 1927500000.

So to C A=1927500000, adding c T = 31877228, we have the Sum = 1959377228 = T A = Sun's Diſtance from the Centre of the Earth in the Sun's *Apogæum*. Accordingly, we have 1895622772 = T B = Sun's Diſtance from the Centre of the Earth in the Sun's *Perigæum*; and ſo we have the Sun's apparent Diameter

meter in the *Perigæum* : to the apparent Diameter in the *Apogæum* :: As 1959377228 :: to 1895622772.

4. So throughout Chap. III. correcting by theſe Proportions, we have, in Num. 4. k g = 1959377228, and k w = 1895622772.

6. Alſo, in Num. 6. k g and k w are the ſame reſpectively.

8. Then, in Num. 8. putting k c — k w, we have c k (the Semidiameter of the Earth) = 63053,28 + [by the like Proof as is uſed for Num. 8.]; *viz.* As the Sine of 55°+54′+06″+20‴ (82807,798) : k e (1895622772) :: ſo Sine of 5″+40‴+57⁗ (2,7544) : 63053,28+ = c k. c k.

9. Then, in Num. 9. putting k w = 189562272, and taking c k = 63053,28, we have the Sum of the two Sides k w and c k = 1895685825,28 +, and we have the Difference of thoſe Sides = 1895559718,72—.

And the Angle c k w being = 100°+36′+51″+56‴+32⁗ [Num. 6.], we have the Sum of the oppoſite Angles = 79°+23′+08″+03‴+28⁗; ſo the half Sum of oppoſite Angles = 39°+41′+34″+01‴+44⁗, and we have the Tangent of this half Sum = 83000,3342; ſo we have the Angle c w k = 6″+44‴+09⁗ [by the like Proof uſed for Num. 9.]. Angle c w k.

So to the apparent Height f k w = 10°+36′+51″+56‴+32⁗ [Num. 3.], adding the Angle c w k, which is the diurnal Parallax correſponding to the Angle f k w (in 1ſt Figure for Chap. III.], we have the Sum = 10°+36′+58″+40‴+41⁗, for the true Height of the Sun at w; *viz.* for the Angle F c w [Num. 6.].

Then Angle F c E being = 34°+05′+53″+30‴ [Num. 1.], ſubſtracting Angle F c w Angle F c E.

out of it, we have the Remainder = Angle wcE. $23^{\circ}+28'+54''+49'''+19'''' =$ Angle wcE.

10. Again, in Num. 10. the Angle ckw being $= 100^{\circ}+36'+51''+56'''+32''''$, [Num. 6.], and the Angle wkg being $= 46^{\circ}+57'+51''+45'''+02''''$ [Num. 5.], and ſo Angle ckg (the Sum of theſe two Angles) being $= 147^{\circ}+34'+43''+41'''+34''''$, we have the half Sum of the oppoſite Angles $= 16^{\circ}+12'+38''+09'''+13''''$, and the Tangent of this half Sum of Angles = 29072,7768.

And having the Sum, and the Difference of the Sides ck, and kg, = 1959440281,28, and 1959314174,72 reſpectively, [from Corrections Angle cgk. for Num. 4. and 8.] we have the Angle cgk $= 3''+30'''+01''''$ [by the like Proof as is uſed for Num. 10.].

So to the apparent Height fkg $= 57^{\circ}+34'+43''+41'''+34''''$ [Num. 2.] adding the Angle cgk, which is the diurnal Parallax correſponding to the Angle ſkg, we have the Sum $= 57^{\circ}+34'+47''+11'''+35''''$, for the true Height of the Sun at g, *viz.* for the Angle Angle Fcg. Fcg [Num. 10. from Num 6.].

Then ſubſtracting Angle FcE $(34^{\circ}+05'+53''+30'')$ out of this Angle Fcg, we have the Remainder $= 23^{\circ}+28'+53''+41'''+35''''$, Angle Ecg. which is the Angle Ecg.

Here Angle Ecg is leſs than Angle wcE, by $1''+07'''+44''''$.

So the Semi-diameter ck muſt be taken > 63053,28+ [by the Corollary from the *Lemma's* in Num. 7.].

11. Let ck = 69900; then kw being = 1895622772, and ck = 69900, we have the Sum of theſe Sides = 1895692672, and we have the Difference of thoſe Sides = 1895552872.

And the Angle c k w being $=100^{\circ}+36'+51''+56'''+32''''$ [Num. 6.], we have half Sum of the oppoſite Angles $=39^{\circ}+41'+34''+01'''+44''''$, and we have the Tangent of this half Sum = 83000,3342 [as in Num. 9.].

So we have the Angle c w k (which is the diurnal Parallax) $= 7''+28'''+06''''$ [by the like Proof uſed for Num. 11.]. Angle c w k.

So to the apparent Height f k w $10^{\circ}+36'+51''+56'''+32''''$, Num. 3.]. adding the parallactick Angle c w k, we have the Sum $= 10^{\circ}+36'+59''+24'''+38''''$ for the true Height of the Sun at w, for the Angle F c w, [in Num. 6.]. Angle F c w.

Then the Angle F c E being $=34^{\circ}+05'+53''+30'''+00''''$ [Number 1.], by ſubſtracting Angle F c w out of it, we have the Remainder $= 23^{\circ}+28'+54''+05'''+22''''=$ Angle w c E. Angle w c E.

12. Then the Angle c k g being equal to $147^{\circ}+34'+43''+41'''+34''''$, [Num. 10.] we have the half of the oppoſite Angles equal to $16^{\circ}+12'+38''+09'''+13''''$, and the Tangent of it = 29072,7788; and, having the Sum of the Sides k g and c k = 1959447128, and the Difference of thoſe Sides = 1959307328, we have the Angle c g k $= 3''+53'''+11''''$ [by the like Proof uſed in Num. 12.].

So to the apparent Height f k g =
° ' '' ''' ''''
57+34+43+41+34 [Numbers 2, 3.]
adding the parallactick Angle c g k equal
3+53+11
——————— we have the Sum =
57+34+47+34+45 for the true Height of the Sun at g; *viz.* for the Angle F c g [as in Num. 6.]. Then, out of Angle F c g ſubſtracting Angle

Angle F c g.

Angle F c E $= 34^{\circ}+05'+53''+30'''+00''''$ [Number 1.], we have the Remainder $=$ Angle E c g. $23^{\circ}+28'+54''+04'''+45'''' =$ Angle E c g.

Here Angle E c g is leſs than Angle w c E by $37''''$; ſo the Semi-diameter c k ought to be taken $>$ 69900 [by the Corollary from the *Lemma* in Num. 7.].

But the ſmall Difference, $37''''$, being inconſiderable, I ſhall take the Semi-diameter of the Earth, c k, to be well determined here by 69900 in proportion to the Semi-axis of the Sun's Orbit $=$ 1927500000.

So by this Determination of c k, the Semi-diameter of the Earth, by the Reaſoning in Num. 13. we have,

The Semi-diameter of the Earth

To the Diſtance betwixt the Centres of the Earth and the Sun
In its *Perigæum* : : as, 69900 : 1895622772.
In its middle Diſtance : : as, 69900 : 1927500000.
In its *Apogæum* : : as 69900 : 1959377228.

And by determining c k to be $=$ 69900, and k w $=$ 1895622772, and k g $=$ 1959377228, we have

The greateſt Declination of the Ecliptick (the Angle w c E, or the Angle E c g) $= 23^{\circ}+28'+54''$ [in Num. 11, and 12.].
And ſo we have the Diſtance of the Tropicks $= 46^{\circ}+57'+48''$.
The ſame as in Chap. III. Num. 13.

14. Then we have the Sun's horizontal diurnal Parallax (which is the greateſt of all),

In the *Perigæum*$=7''+36'''+25''''$
[as in the firſt Proof.].
In the mid. Diſt.$=7+28+58$
[as in the ſecond Proof.].
In the *Apogæum*$=7+21+44$
[as in the third Proof.].

PROOFS

For Num. 14.

By 5th Caſe of right-angled Triangles, *Caſwell*.

Firſt PROOF.

As kf (1895622772) : to ck (69900) :: So Radius (100000) : $\frac{6990000000}{1895622772}=3,6874+=$ Tangent of Angle of cfk$=$Tangent $7''+36'''+25''''$.

Second PROOF.

As kf (1927500000) : to ck (69900) : : So Radius (100000) : $\frac{6990000000}{1927500000}=3,6265-=$ Tangent of Angle cfk$=$Tangent of $7''+28'''+58''''$.

Third PROOF.

As kf 1959377228) : to ck (69900) :: So Radius (100000) : $\frac{6990000000}{1959377228}=3,5675-=$ Tangent of Angle cfk$=$Tangent of $7''+21'''+44''''$.

And putting the Angle fkw orderly, = 1°, 2°, 3°, and ſo on, we have the Angle ckw orderly = 91°, 92°, 93°, and ſo on. And, having the common Side ck = 69900, and putting kw in one Table = 1895622772, and in ſecond Table putting kw = 1927500000, and n a third Table putting kw = 1959377228, and alculating according to the fourth Caſe of oblique ngled Triangles, *Caſwell*, and by the Method uſed

2

uſed in the Proof for Num. 11. we ſhall have the parallactick Angles correſponding to each of thoſe Diſtances of the Sun's Centre from th Earth at all Altitudes above the ſenſible Horizon; which Angles being orderly placed in their reſpective Tables, we ſhall be able expeditiouſly to perform the Operations which require the Determination of the Sun's diurna Parallax.

15. And, dividing 1895622772 by 69900 we have the Quotient = 27119+, which i the Number of Semi-diameters of the Earth, b which the Centre of the Sun is diſtant from th Centre of the Earth in its *Perigæum*.

And, dividing 1927500000 by 69900, w have the Quotient = 27575+, which is th Number of Semi-diameters of the Earth, b which the Centre of the Sun is diſtant from th Centre of the Earth at its middle Diſtance.

And, dividing 1959377228 by 69900, w have the Quotient = 28031+, which is th Number of Semi-diameters of the Earth, b which the Centre of the Sun is diſtant from th Centre of the Earth in its *Apogæum*.

Or, expreſſing the Semi-diameter of the Eart ck, by 22095202 *Engliſh* Feet, as it is dete mined to be [Chap. II. Sect. 3. Num. 3.]

Then, by the Rule of Three, we have t Sun's Diſtance from the Centre of the Earth

$$\frac{1895622772 \times 22095202}{69900} = 5992013027$$

Engliſh Feet; or dividing by 5280, the Numb of Feet in an *Engliſh* Mile, = 113485095 *Engliſh* Miles in the *Perigæum*.

Again, by the Rule of Three, we have t Sun's Diſtance from the Centre of the Earth

19275000

$\frac{1927500000 \times 22095202}{69,00} = 609277565888$ — *Engliſh* Feet; or, dividing by 5280, the Number of Feet in an *Engliſh* Mile $= 115393478 +$ *Engliſh* Miles at the Sun's middle Diſtance from the Centre of the Earth.

Again, by the Rule of Three, we have the Sun's Diſtance from the Centre of the Earth $= \frac{1959377228 \times 22095202}{69900} = 619353871915$ *Engliſh* Feet; or, dividing this by 5280, the Number of Feet in an *Engliſh* Mile, 117301870— *Engliſh* Miles = Sun's Diſtance from the Centre of the Earth in the *Apogæum*.

16. In Num. 16. for Seven Seconds + Thirty-nine Thirds + Thirteen Fourths, read Seven Seconds + Thirty-ſix Thirds + Twenty-five Fourths. And for Twenty-ſeven Thouſand Semidiameters of the Earth, read Twenty-ſeven thouſand One hundred and Nineteen Semidiameters of the Earth.

17. In Num. 17. for Twenty-ſeven thouſand Semidiameters of the Earth, when the Sun is in its *Perigæum*; and for Twenty-eight thouſand and Seventy-one Semidiameters of the Earth, when the Sun is in its *Apogæum*; and for more than Fifty-five thouſand and Seventy-one Semidiameters of the Earth; read reſpectively, Twenty-ſeven thouſand One hundred and Nineteen Semidiameters of the Earth; and Twenty-eight Thouſand and Thirty-one Semidiameters of the Earth and Fifty-five thouſand One hundred and Fifty Semidiameters of the Earth.

18. In Num. 18. for 14583333333, read 14562500000; andfor 70000, read 69900; and for 14583263333, read 14562430100; and for

18438263333, read 18417430100; and for 107282633,3, read 10707430100; and for 53316,53 +, read 53273,188 +; and for $28^\circ+03'+53''+55'''+57''''$, read $28^\circ+02'+44''+20'''+48''''$. And for $70^\circ+33'+53''+55'''+57''''$, read $70^\circ+32'+44''+20'''+48''''$. And for $14^\circ+26'+06''+24'''+3''''$, for Angle zB6, read $14^\circ+27'+15'+39''++12''''$.

OF THE
MOTION
OF THE
SUN.

CHAP. VI.

Of the Diſtances of the Apogæum *of the Sun's Orbit, and the Sun's Diſtances from the* Vernal Equinox; *both according to the Middle and the Apparent Motions, and the Sun's Right Aſcenſions at the Radices of ſeveral* Julian *Years of* Chriſt.

Of the Method of calculating an Ephemeris *of the Sun's daily Geocentrick Motions, and a Method for determining the Moments of Apparent Time of the Sun's Ingreſs into any of the Signs of the Ecliptick.*

SECT. I.

LET it be required to determine the Diſtance of the *Apogæum* of the Sun's Orbit, and the Sun's Diſtances from the Vernal Equinox (from the Beginning of the Sign ♈ of the Ecliptick), both according to the middle Motion and the apparent Motion, and the Sun's right Aſcenſion at Noon First Example.

at *Greenwich*, at the Beginning of the 31ſt aſtronomical Day of *December* (*O. S.*) at the End of the *Julian* Year of Chriſt 1720, which Moment I call the Radix of the *Julian* Year of Chriſt 1721.

Radix of *Julian* Year of Chriſt See the Note at End of 6th Operation.

The Account begins from Noon at *Greenwich* at the Beginning of the 14th aſtronomical Day of *July (O S.)* in the *Julian* Year of Chriſt 1711; and it proceeds forwards, being divided into ſeveral Operations in Order; as in the Scheme annexed.

1ſt, Betwixt Noon on the ſaid 14th of *July* in the ſaid Year 1711, and Noon on the 14th Day of *July* (*O. S*) in the *Julian* Year of Chriſt 1720, there were Nine *Julian* Years and One Day over and above, there being Three intercalary Days in thoſe Nine Years, becauſe the Years 1712, 1716, and 1720, were *Biſſextile* Years.

For 1ſt Operation.

And there were 170 Days betwixt the ſaid Noons on *July* 14th, and *December* the 31ſt in the ſaid Year 1720. So, in my 1ſt Operation, I ſet down the Sun's middle Motion in its Orbit, and the Motion of the Sun's *Apogæum*, from my Tables, correſponding to thoſe Years and Days of equal Time, and the Sums of theſe Motions; as in the Scheme.

$\xi m + \frac{\xi}{z}$

I call the Sum of theſe Motions $\xi m + \frac{\xi}{z}$, where ξ is the Sun's middle Motion under the Ecliptick in One Day of equal Time; and m is the known Number of the Days, and $\frac{\xi}{z}$ denotes the aliquot Parts of One Day, if there be ſuch Parts. [See Chap. V. Num. 14.].

2. In my ſecond Operation I ſet down the Place of the Sun's *Apogæum* at the ſaid Noon, on the ſaid 14th of *July*, in the ſaid Year of

Chriſt 1711; which I call my Radical Moment.

Radical Moment, for 2d Operation.

That Place I found to be $6\ \text{Sig.} + 07^\circ + 51' + 43'' + 50''' + 48''''$ Eaſtward from ♈ [Chap. V. Sect. 3. 4th Proceeding, Num. 1.]; and thereto adding the Motion of the *Apogæum* in the Interval of equal Time, deſcribed in the 1ſt Operation, I find the Place of the *Apogæum* of the Sun's Orbit, at the End of that Interval of equal Time; as in the Scheme.

Next, I ſet down the Place of the Sun's middle Motion under the Ecliptick, at the radical Moment, which I found $4\ \text{Sig.} + 02^\circ + 34' + 19'' + 09''' + 57''''$ Eaſtward from ♈ [*Ibid.* Num. 2.].

And adding hereto $\xi\,\text{m} + \frac{\xi}{z}$, I find the Place of the Sun's middle Motion under the Ecliptick at the End of that Interval of equal Time; as is expreſſed in the Scheme.

Next, ſubſtracting the Diſtance of the *Apogæum* Eaſtward, from ♈, at the End of the Interval of equal Time forward, we have the Remainder = mean Anomaly at the End of that Interval of equal Time forward.

3. In my 3d Operation, I firſt find the Equation of the Sun's elliptical Orbit correſponding to the mean Anomaly, as follows:

For 3d Operation.

In my Table of the Equations of the Sun's elliptical Orbit, I find the Equation correſponding to $6\ \text{Sig.} + 13^\circ + 26' + 18'' + 35''' + 21'''' = 5682921''''$. And I find the Equation correſponding to $6\ \text{Sig.} + 12^\circ = 24' + 19'' + 08''' + 26'''' = 5252906''''$. So ſubſtracting, we have the Difference betwixt theſe two Equations $= 430015'''' = D$.

And the prime Scruples, &c. annexed in the mean Anomaly, $= 56' + 44'' + 23''' + 56'''' = 12255836''''$. Then ſay, As $1^{\circ}\ (12960000'''')$: Difference $(430015'''')$ :: ſo the Scruples annexed $(1225836'''')$: $406651'''' = 1'+52''+57'''+31''''$.

Mean Anomaly. This being added to the Equation correſponding to 6 Sig. + 12°, we have the Sum $= 26'+12''+05'''+57''''$, for the Equation of the Orbit correſponding to the mean Anomaly $=$ 6 Sig. $+\ 12^{\circ}+56'+44''+23'''+56''''$.

So becauſe this mean Anomaly is $>$ 6 Signs; therefore adding this Equation of the Orbit to the Sun's middle Motion under the Ecliptick, at the End of the Interval of equal Time forward, we have the Sum for the Place of the Sun's apparent Motion under the Ecliptick at the End of the Interval of equal Time forward [Chap. IV. Sect. 1. Num. 7.].

For 4th Operation. 4. In my 4th Operation, I firſt find the Sun's right Aſcenſion at the End of the Interval of equal Time forward, as follows:

In my Table of the Sun's right Aſcenſions I find the right Aſcenſion of 22° of ♑ $=$

$$\overset{\circ}{293}\ (\overset{\text{Sig.}}{9}+\overset{\circ}{23})+\overset{\prime}{46}+\overset{\prime\prime}{25}+\overset{\prime\prime\prime}{32}+\overset{\prime\prime\prime\prime}{14}$$

the right Aſcenſion of 21° of ♑ $=$

$$292\ (9+22^{\circ})+42+37+32+21$$

---

then ſubſtracting, we have the Difference $=$

$$1+03+47+59+53$$

$=13780793$. And the prime Scruples, &c. annexed to 21° of ♑, ſetting forth the Place of the Sun's apparent Motion at the End of the Interval of equal Time forward, are $22'+33''+31'''+36''''=4872696''''$. Then ſay, As $1^{\circ}\ (12960000'''')$: Difference $(13780793'''')$ :: ſo the Scruples annexed $(4872696'''')$: $5181297''''$ $+=23'+59''+14'''+57+''''$ This being added to the right Aſcenſion of 21° of ♑, we have the Sum $=$ 9 Sig. $+\ 23^{\circ}+06'+36''+47'''+18''''$, which was the Sun's right Aſcenſion at the End of the Intetval of equal Time forward; which I ſet down firſt in the Scheme in my 4th Operation.

Next I ſet down the Sun's right Aſcenſion at the radical Moment from which my Account began, which I found to be $= 4$ Sig. $+ 04^{\circ} + 02' + 57'' + 56''' + 22''''$ [Chap. V. Sect. 1. Num. 5].

Then for determining the aſcenſional Difference, let the Arch B ♈ E of the Equinoctial, be the right Aſcenſion of the Point Q of the Ecliptick, where the Sun was at the radical Moment, the Arch B ♈ E being $= 4$ Sig. $+ 04^{\circ} + 02' + 57'' + 56''' + 22''''$ [in 2d Figure].

Aſcenſional Difference.

At the End of the Interval of equal Time forward, the Sun having been then at the Point N of the Ecliptick, and the Sun's right Aſcenſion being then the Point m, or the Semicircle B ♈ E K + Arch K ♈ m of the equinoctial Circle, then the intercepted Arch, which was the aſcenſional Difference, was the Arch E m of the Equinoctial, ſo from the Sun's right Aſcenſion, B ♈ E K + K ♈ m =

$$\begin{array}{cccccc} \text{Sig.} & {}^{\circ} & ' & '' & ''' & '''' \\ 9 & + 23 = & 06 & + 36 & + 47 & + 18, \end{array}$$

ſubſtracting Arch B ♈ E =

$$4 + 04 + 02 + 57 + 56 + 22,$$

---

we have the Remainder the intercepted Arch E m

$$= 5 + 19 + 03 + 38 + 50 + 56$$

= the aſcenſional Difference [as in Chap. V. Sect. 1. Num. 13. 1ſt Inſtance, 1ſt Caſe].

Then comparing $\xi m + \frac{\xi}{z}$ [in 1ſt Operation] herewith, I find this aſcenſional Difference exceeds $\xi m + \frac{\xi}{z}$ by $0^{\circ} + 41' + 36'' + 35''' + 14''''$, and by my Table of the equal Time taken up, &c. I determine the equal Time taken up whilſt the Arch of the Equinoctial $= 41' + 36'' + 35''' + 14''''$ was rolling weſtward, under Semimeridian of G, by the diurnal Motion, which, I find, did take up 2 Minutes + 45 Seconds + 59 Thirds + 05 Fourths.

Equation of Time.

This is the Equation of Time, which in this Caſe, becauſe the aſcenſional Difference $> 5\,m + \frac{5}{2}$ of a Day, I add to the Year's and Day's Motion of equal Time, ſet forth in the 1ſt Operation, give a Sum of equal Time = the apparent Time betwixt the Noon at *Greenwich*, on the ſaid 14th Day of *July*, in the Year 1711, and the Noon at *Greenwich*, at the Beginning of the 31 aſtronomical Day of *December* (*O. S.*) at the End of the *Julian* Year of Chriſt 1720, forward. [See below, Num. 7.].

Note here, I call this Noon, on the ſaid 31ſt Day of *December*, at the End of the *Julian* Year of Chriſt 1720, the Radix of the *Julian* Year of Chriſt, 1721.

For the like Reaſon, I call the Noon at the Beginning of the 31ſt aſtronomical Day of *December* (*O. S.*) at the End of the *Julian* Year of Chriſt 1740, the Radix of the *Julian* Year of Chriſt 1741.

For 5th Operation.

And ſo on in all like Inſtances, both forward and backward.

5. In my 5th Operation, I firſt ſet down the Sun's middle Motion in its Orbit, and the Motion of the *Apogæum*, and the Sum of theſe Motions during the Equation of Time.

Next, to the Place of the *Apogæum* at the End of the Interval of equal Time forward, I add the Motion of the *Apogæum* during the Equation of Time; and I ſet down the Sum of theſe two for the Place of the Sun's *Apogæum*, at the

End of the Interval of apparent Time forwards. [See Num. 7. below].

Next, to the Place of the Sun's middle Motion, under the Ecliptick, at the End of the Interval of equal Time forward, I add the Sum of both Motions during the Equation of Time; the Sum of theſe gives the Place of the Sun's middle Motion under the Ecliptick, at the End of the Interval of apparent Time forwards. [See Num. 7. below].

For 6th Operation.

6. In my 6th Operation; firſt, from the Place of the Sun's middle Motion under the Ecliptick, at the End of the Interval of apparent Time forward, I ſubſtract the Diſtance of the *Apogæum* Eaſtward from ♈, at the End of that Interval of apparent Time forward; and I ſet down the Remainder for the mean Anomaly at the End of that Interval of apparent Time forward.

Next, I ſet down the Equation of the Sun's Orbit correſponding to the mean Anomaly, as follows:

$$\left.\begin{array}{r}\text{Mean Anomaly}\\ \text{at the End of}\\ \text{the Interval of}\\ \text{apparent Time}\\ \text{forwards ——}\end{array}\right\}\begin{array}{l}\text{Sig.}\quad\;\; {}^{\circ}\qquad {}'\qquad {}''\qquad {}'''\qquad {}''''\\ =6+12+56+51+12+55\end{array}$$

$$\left.\begin{array}{r}\text{Prime Scruples,}\\ \text{\&c. annexed} =\end{array}\right\}\qquad 56+51+12+55$$

$=12280375''''$.

Then, by the Reaſoning for the 3d Operation ſay,

As 1° ($12960000''''$) : Difference ($430015''''$) : : ſo the Scruples annexed ($+12280375''''$) : $407465'''''$ — $= 1' + 53'' + 11''' + 05''''$.

This being added to the Equation for 6 Signs + 12°, we have the Sum $= 26' + 12'' + 19''' + 31''''$, for the Equation of the Orbit correſponding to the mean Anomaly $=$ 6 Sig. $+ 12^{\circ} + 56' + 51'' + 12''' + 55''''$.

And becauſe this mean Anomaly $>$ 6 Signs, therefore, adding the Equation of the Orbit to the Place of the Sun's middle Motion under the Ecliptick at the End of the Interval of apparent Time forward, we have the Sum for the Place of the Sun's apparent Motion under the Ecliptick at the End of the Interval of apparent Time forward.

Laſtly, I ſet down the Sun's right Aſcenſion at the End of this Interval of apparent Time forward, as follows:

The Difference betwixt the right Aſcenſions of 22° of ♑, and of 21° of ♑ $= 13780793''''$ [as in the Account for 4th Operation].

And the prime Scruples, *&c.* annexed in the Sun's apparent Place at the End of the Interval of apparent Time forward, are $22' + 40'' + 34''' + 10'''' = 4898050''''$. Then, according to the Calculation for 4th Operation, ſay,

As 1° ($12960000''''$) : to the Difference ($13780793''''$) : : ſo the Scruples annexed ($4898050''''$) : $5208257'''' = 24' = 06'' = 44''' = 17''''$.

Adding this to the right Aſcenſion of 21° of ♑, we have the Sum $=$ 9 Sig. $+ 23^{\circ} + 06' + 44'' + 16''' + 38''''$, for the right Aſcenſion of the Sun at Noon at *Greenwich*, at the Beginning of the 31ſt aſtronomical Day of *December (O. S.)* at the End of the *Julian* Year of Chriſt 1720, or at the Radix of the *Julian* Year of Chriſt 1721.

1ſt Caſe. 7. Note here, when the Account proceeds forward, if the aſcenſional Difference be $>$ $\xi m + \frac{\xi}{z}$ (as in this 1ſt Example, 4th Operation), which is my 1ſt Caſe, then the Equation of the Time is to be added to the equal Time contained

tained in the Interval of Time denominated by $\xi\ m + \frac{\xi}{z}$ of the Ecliptick; becauſe, in this Caſe, the Quantity of equal Time denominated by $\xi\ m + \frac{\xi}{z}$ of the Eliptick, did come ſhort of the Quantity of apparent Time contained in the Interval, which I here denominate by $\zeta\ m + \frac{\zeta}{z}$ of the Equinoctial, by the Space of equal Time taken up, whilſt the Arch $C\ m + \frac{\xi}{z}$ — Arch $\xi\ m - \frac{\xi}{z}$ of the Equinoctial was rolling Weſtward under the Semimeridian of G [compare herewith the Account in the 4th Operation, and in Chap. V. Sect. 1. Num. 5, 7, and 14.]. And, in conſequence of the Addition of this Equation of Time to the equal Time, the Motion of the *Apogæum* during the Equation of Time muſt be added forward to the Place of the *Apogæum* at the End of the Interval of equal Time forward; becauſe in this Caſe the *Apogæum* did proceed farther forward than is its Motion through the Arch $\xi\ m + \frac{\xi}{z}$, by its Motion during the Equation of Time; and accordingly ſo I have ſet it down in the Scheme in the 5th Operation.

Alſo, in conſequence of the Addition of this Equation of Time to the equal Time, the Sum of both Motions during the Equation of Time muſt be added forward to the Place of the Sun's middle Motion under the Ecliptick, at the End of the Interval of equal Time forward, for the like Reaſon as is given for the Addition of the Motion of the *Apogæum* forward during the Equation of Time.

2d Caſe. But when the Account proceeds forward, if on the other hand the aſcenſional Difference be $< \xi m + \frac{\xi}{z}$, which is my ſecond Caſe, then the Equation of the Time muſt be ſubſtracted from the equal Time, becauſe, in this Caſe, the Quantity of equal Time contained in the Interval denominated by $\xi m + \frac{\xi}{z}$ of the Ecliptick, did exceed the apparent Time contained in the Interval denominated by $\zeta m + \frac{\zeta}{z}$ of the Equinoctial, by the Space of equal Time taken up, whilſt $\xi m + \frac{\xi}{z} - \zeta m - \frac{\zeta}{z}$ was rolling Weſtward under the Semimeridian of G, by the diurnal Motion [See Chap. V. Sect. 1. Numbers 4, 6, and 14.]. And, in conſequence of the Subſtraction of this Equation of Time from the equal Time, the Motion of the *Apogæum* during the Equation of Time muſt be ſubſtracted backward from the Place of the *Apogæum* at the End of the Interval of equal Time forward; becauſe, in this Caſe, the *Apogæum* did not proceed ſo much forward (ſo much, according to the Order of Signs) as is its Motion through the Arch $\xi m + \frac{\xi}{z}$ of the Ecliptick, by its Motion during the Equation of Time.

Alſo, in conſequence of the Subſtraction of this Equation of Time from the equal Time, the Sum of both Motions, during the Equations of Time, muſt be ſubſtracted from the Place of the Sun's middle Motion under the Ecliptick at the End of the Interval of equal Time forward, for the like Reaſon as is given for the Subſtraction of the Motion of the *Apogæum* backward during the Equation of Time.

SCHEME

SCHEME *for calculating the Places of the* Sun's Apogæum, *of the* Sun's *middle Motion, and of the* Sun's *apparent Motion under the Ecliptick, and the* Sun's *right Aſcenſion at Noon at* Greenwich, *at the Beginning of the 31ſt Aſtronomical Day of* December (*O. S.*) *at the End of the* Julian *Year of Chriſt* 1720, *of apparent Time.*

For Chap. VI, Sect. 1. 1ſt Example.

See the Proofs of Particulars in Chap. VI. Sect. 1. 1ſt Example.

THE Account begins at Noon at *Greenwich* of apparent Time, at the Beginning of the 14th aſtronomical Day of *July* (*O. S.*) in the *Julian* Year of Chriſt 1711, which I call my Radical Moment, ſo the Account proceeds forward. And the Interval of Time betwixt the Moment at the Beginning, and the Moment at the End of that Interval, contains Nine *Julian* Years + 171 Days of apparent Time.

Radical Moment.

1ſt Operation.

Sun's middle Motion in its Orbit
In Nine *Julian* Years of equal Time =
Motion of *Apogæum*.

Sig. ° ′ ″ ‴ ⁗ ° ′ ″ ‴ ⁗
11+29+41+48+11+29 0+07+29+46+58
In 171 Days of equal Time =
5+18+32+20+53+18 0+00+23+23+57

Sum of middle Motion in Orbit =
5+18+14+09+04+47 0+07+53+10+55
Sum of Motion of *Apogæum*
0+00+07+53+10+55

Sum of both Motions =
5+18+22+02+15+42 = Sun's middle Motion under the Ecliptick, above the intire Revolutions

lutions in this Interval of equal Time $= \xi m + \frac{\xi}{z}$.

2d Operation. Place of *Apogæum* at the Radical Moment

Sig. ° ′ ″ ‴ ⁗

=3+07+51+43+50+48 Eaſtward from ♈.

Add Motion of *Apogæum* in Interval of equal Time forward; the Sum gives

=3+07+59+37+01+43 Eaſtward from ♈

Place of *Apogæum* at the End of Interval of equal Time forward.

Place of the Sun's Middle Motion at the Radical Moment

4+02+34+19+09+57.

Add $\xi m + \frac{\xi}{z}$ hereto, the Sum gives

=9+20+56+21+25+39 Eaſtward from ♈,

Place of Sun's middle Motion at the End of Interval of equal Time forward.

Subſtract the Diſtance of the *Apogæum* Eaſtward from ♈, at End of Interval of equal Time forward, the Remainder gives

=6+12+56+44+23+56.

Mean Anomaly at the End of the Interval of equal Time forward.

3d Operation. Equation of Sun's Orbit.

=0+00+26+12+05+57. Adding this to the Place of the Sun's middle Motion at the End of Interval of equal Time forward, Sum

Sig. ° ′ ″ ‴ ⁗

9+21+22+33+31+36 Eaſt. from ♈, or under

21+22+33+31+36 of ♑.

Gives the Place of the Sun's apparent Motion [at the End of Interval of equal Time forward].

4th Operation. Sun's right Aſcenſion at the End of the Interval of equal Time forward.

Sig. ° ′ ″ ‴ ⁗

=9+23+06+36+47+18

Sun's right Aſcenſion at the Radical Moment.

$$\begin{array}{cccccc} \text{Sig.} & {}^{\circ} & {}' & {}'' & {}''' & {}'''' \\ =4 & +04 & +02 & +57 & +56 & +22 \end{array}$$

Subſtract the Sun's right Aſcenſion at Radical Moment from the Sun's right Aſcenſion at End of Interval of equal Time forward.

Remainder = aſcenſional Difference, at the End of equal Time forward

$=5+19+03+38+50+56$

This aſcenſional Difference $> \xi m + \frac{\xi}{z}$ by $41'+36''+35'''+14''''$.

And the equal Time taken up, whilſt this Arch of the Equinoctial was rolling by the diurnal Motion under the Semimeridian of G, was = 2 Minutes + 45 Seconds + 59 Thirds + 05 Fourths [by my Table of equal Time taken up, *&c.*]

This is the Equation of Time, which, becauſe the aſcenſional Difference $> \xi m + \frac{\xi}{z}$ muſt be added to the Nine *Julian* Years + 171 Days of equal Time forward, to give a Sum = the Nine *Julian* Years + 171 Days of apparent Time forward, betwixt the ſaid Noon at *Greenwich* on the ſaid 14th of *July* in the ſaid Year 1711, and the ſaid Noon at *Greenwich*, forward, on the ſaid 31ſt of *December* at the End of the *Julian* Year of Chriſt 1720 of apparent Time, which Moment, with me, is the Radix of the *Julian* Year of Chriſt 1721.

5th Operation.

	$''$	$'''$	$''''$
Sun's middle Motion in Orbit, during Equation of Time =	06	+48	+59 +
Motion of *Apogæum*, during Equation of Time =	00	+00	+01
Sum of both Motions during Equation of Time =	06	+49	+00

0

To Place of *Apogæum* at End of Interval of equal Time forward, add Motion of *Apogæum* during Equation of Time; Sum gives Place of *Apogæum* at the End of Interval of apparent Time forward,

Sig. ° ′ ″ ‴ ⁗
=3+07+59+37+01+44 Eaſtward from ♈.

To Place of Sun's middle Motion under the Ecliptick at the End of Interval of equal Time forward, add Sum of both Motions during Equation of Time; Sum gives Place of Sun's middle Motion under Ecliptick, at the End of Interval of apparent Time forward,

Sig. ° ′ ″ ‴ ⁗
=9+20+56+28+14+39 Eaſtward from ♈.

6th Operation. From Place of Sun's middle Motion under Ecliptick at End of Interval of apparent Time forward, ſubſtract Diſtance of *Apogæum* Eaſtward from ♈ at End of Interval of apparent Time forward, we have Remainder = Mean Anomaly at End of Interval of apparent Time forward,

Sig. ° ′ ″ ‴ ⁗
=6+12+56+51+12+55.

Equation of Sun's Orbit correſponding =0+00+26+12+19+31.

Adding this to Place of Sun's middle Motion under Ecliptick at the End of Interval of apparent Time forward, we have the Sum for Place of Sun's apparent Motion at the End of Interval of apparent Time forward,

Sig. ° ′ ″ ‴ ⁗
=9+21+22+40+34+10 Eaſtward from ♈ or under 21°+22′+40″+34‴+10⁗ of ♑.

And the Sun's right Aſcenſion at End of this Interval of apparent Time forward = 9 Sig. +23°+06′+44″+16‴+38⁗, namely, at Noon at *Greenwich*, at the Beginning of the 31th Day of *December* (O. S.) at the Radix of the *Julian* Year of Chriſt 1721. of apparent Time.

Let it be required to determine the Diſtance of the Apogæum of the Sun's Orbit, and the Sun's Diſtances from the Vernal Equinox (from the Beginning of the Sign ♈ of the Eclíptick) both according to the Middle Motion and the apparent Motion, and the Sun's right Aſcenſion, at Noon, at *Greenwich*, at the Beginning of the 31th Aſtronomical Day of *December* (O. S.) at the End of the *Julian* Year of Chriſt 1700: Which Moment I call the Radix of the *Julian* Year of Chriſt 1701.

2d Example.

Radix of the Julian Year of Chriſt.

The Account begins from Noon, at *Greenwich*, at the Beginning of the 14th Aſtronomical Day of *July* (O. S.), in the *Julian* Year of Chriſt 1711: So the Account proceeds backwards, and is divided into ſeveral Operations in Order; as in the Scheme annexed.

See the Note at the End of 6th Operation.

1. Betwixt Noon, on the ſaid 14th Day of *July*, in the ſaid Year of Chriſt 1711; and Noon on the 14th Day of *July* (O. S.) in the *Julian* Year of Chriſt 1701. there were Ten *Julian* Years backward.

And betwixt the ſaid Noons on the ſaid *July* the 14th, in the ſaid Year 1701, and the ſaid 31ſt of *December*, at the End of the ſaid Year of Chriſt 1700, there were 195 Days backward. So,

In my Firſt Operation I ſet down the Sun's middle Motion in its Orbit, and the Motion of the Sun's Apogæum from my Tables, correſponding to thoſe Years and Days of equal Time, and the Sums of theſe Motions, as in the Scheme.

For 1ſt Operation

ξ ♏ $+ \frac{\xi}{z}$

I call the Sum of theſe Motions $=\xi\,♏+\frac{\xi}{z}$, where ξ is the Sun's middle Motion under the Ecliptick, in one Day of equal Time; and ♏ denotes the known Number of the Days; and $\frac{\xi}{z}$ are the Aliquot Parts of one Day, if there be any ſuch Parts or Part.

For 2d Operation. Radical Moment.

In my Second Operation I ſet down the Place of the Sun's Apogæum, at the ſaid Noon on the ſaid 14th of *July*, in the ſaid Year of Chriſt 1711; which I call my radical Moment.

That Place I found to be 3 Sig. $+07^{\circ}+51'+43''+50'''+48''''$ Eaſtward from ♈ [Chap. V. Sect. 3. 4th Proceeding, Num. 1.] And from that Place, ſubſtracting the Motion of the Apogæum in the Interval of equal Time ſet down in the Firſt Operation, I find the Place of the Apogæum of the Sun's Orbit at the End of that Interval of equal Time backward, as is ſet down in the Scheme.

Next, I ſet down the Place of the Sun's middle Motion under the Ecliptick, at the radical Moment; which I found to be 4 Sig. $+02^{\circ}+34'+19''+09'''+57''''$ Eaſtward from ♈ [Ibid. Num. 2.].

And ſubſtracting from this Place $\xi\,♏+\frac{\xi}{z}$, I find the Place of the Sun's middle Motion under the Ecliptick, at the End of the Interval of equal Time backward, to have been diſtant Eaſtward from ♈; as is expreſſed in the Scheme.

Next, ſubſtracting the Diſtance of the Apogæum Eaſtward from ♈, at the End of the Interval of equal Time backward, we have the Remainder = the mean Anomaly, at the End of that Interval of equal Time backward.

For 3d Operation.

3. In my Third Operation, I firſt find the Equation of the Sun's Orbit correſponding to the mean Anomaly, as follows.

In my Table of the Equations of the Sun's elliptical Orbit, I find the Equation correſponding to 6 Sig. $+ 14^{\circ} = 28' + 7'' + 27''' + 54'''' = 6110874''''$; and I find the Equation correſponding to 6 Sig. $+ 13^{\circ} = 26' + 18' + 35''' + 21'''' = 5682921''''$. Then ſubſtracting, we have the Difference betwixt theſe Two Equations $= 427953''''$: And the prime Scruples, *&c.* annexed in the mean Anomaly, $= 04' + 19'' + 25''' + 20'''' = 933920''''$. Then ſay;

As 1° ($12960000''''$) : Difference ($427953''''$) : : So the Scruples annexed ($933920''''$) : $30839'''' = 08'' + 33''' + 59''''$. Adding this to the Equation for 6 Signs $+ 13^{\circ}$, we have the Sum $= 26' + 27'' + 09''' + 20''''$, for the Equation of the Orbit correſponding to the mean Anomaly $=$ 6 Signs $+ 13^{\circ} + 04' + 19'' + 25''' + 20''''$.

So becauſe this mean Anomaly is $>$ 6 Signs: Therefore, adding this Equation of the Orbit to the Sun's middle Motion under the Ecliptick at the End of the Interval of equal Time backward, we have the Sum for the Place of the Sun's apparent Motion under the Ecliptick, at the End of the Interval of equal Time backward. [See Chap. IV. Sect. 1. Num. 7.]

For 4th Operation.

4. In my Fourth Operation, I firſt find the Sun's right Aſcenſion at the End of the Interval of equal Time backward: Then I ſet down the Sun's right Aſcenſion at the radical Moment; and then I determine the aſcenſional Difference, as follows.

In my Table of the Sun's right Aſcenſions, I find

The right Aſcenſion of 22° of ♑ = 293° (9 Sig. + 23°) + 46′ + 25″ + 32‴ + 14⁗.

The right Aſcenſion of 21° of ♑ = 292° (9 Sig. + 22°) + 42′ + 37″ + 32‴ + 21⁗. And ſubſtracting, we have the Difference, = 1° + 03′ + 47″ + 59‴ + 53⁗ = 13780793⁗. And the prime Scruples, &c. annexed to 21° of ♑, ſetting forth the Place of the Sun's apparent Motion, at the End of the Interval of equal Time backward, are 13′ + 44″ + 00‴ + 48⁗ = 2966448⁗. Then ſay;

As 1° (12960000⁗) : to the Difference (13780793⁗) :: ſo the Scruples annexed (2966448⁗) : 3154321⁗ = 14′ + 36″ + 12‴ + 01⁗.

This being added to the right Aſcenſion of 21° of ♑, we have the Sum = 9 Sig. + 22° + 57′ + 13″ + 44‴ + 22⁗; which was the right Aſcenſion of the Sun, at the End of the Interval of equal Time backward.

Next, I ſet down the Sun's right Aſcenſion at the radical Moment, from which my Account began; which I found to be = 4 Signs + 04° + 02′ + 57″ + 56‴ + 22⁗ [Chap. V. Sect. 1. Num. 5.].

Then, for determining the aſcenſional Difference, let the Arch of the Equinoctial B α E be the right Aſcenſion of the Point Q of the Eclipticks, where the Sun was at the radical Moment; the Arch B α E being = 4 Signs + 04° + 02′ + 57″ + 56‴ + 22⁗ (in 2d Figure).

At the End of the Interval of equal Time backward, the Sun having been then at the Point N of the Ecliptick, and the Sun's right Aſcenſion being then the Point M, or the Semicircle B α E K + Arch K α M of the equinoctial Circle, which is > the Arch B α E; then the intercepted Arch, which was the aſcenſional Difference, was the Sum of the Arch E α B, in 2d Figure, and of the Arch B M, in 1ſt Figure, proceeding contrary to the Order of Signs from E through α and B to M, in 1ſt Figure [as in Chap. V. Sect. 1. Num. 13. 1ſt Inſtance, 2d Caſe].

So, the Sun's right Aſcenſion at the radical Moment (the Arch B α E) being = 4 Signs $+04^{\circ}+02'+57''+56'''+22''''$;

Arch B α E.

And the Sun's right Aſcenſion at the End of the Interval of equal Time backward being = 9 Sig. $+22^{\circ}+57'+13''+44'''+22''''$, ſubſtracting this from 12 Signs, we have the Remainder = Arch B M = 2 Signs $+07^{\circ}+02'+46''+15'''+38''''$. So we have the Sum of theſe two Arches = 6 Signs $+11^{\circ}+5'+44''+12'''+00''''$, which was the intercepted Arch, or the aſcenſional Difference, betwixt the Sun's right Aſcenſion at the radical Moment, and the Sun's right Aſcenſion at the End of the Interval of equal Time backward; which I ſet down next in the Scheme [See Num. 7. below].

Arch B M.

Aſcenſional Difference.

Then, comparing ξ ♏ $+\frac{\xi}{z}$ [in 1ſt Operation] with this aſcenſional Difference, I find this aſcenſional Difference is $<\xi$ ♏ $+\frac{\xi}{z}$ by $41'+18''+06'''+29''''$; and by my Table of the equal Time taken up, *&c.* I determine the equal Time whilſt the Arch of the Equinoctial equal to $41'+18''+06'''+29''''$ was rolling under the Semimeridian of G by the diurnal Motion, to be equal to 2 min.+44 ſec.+45 thirds+21 fourths. This is the Equation of Time, which in this Caſe I ſubſtract from the Years and Days of equal Time ſet forth in the 1ſt Operation, to give a Remainder of equal Time equal to the Years and

Equation of Time.

and Days of apparent Time betwixt the Noon at *Greenwich*, at the Beginning of the 14th aſtronomical Day of *July*, in the *Julian* Year of Chriſt 1711 aboveſaid, and the Noon at *Greenwich* at the Beginning of the 31th aſtronomical Day of *December* (O. S.), at the End of the *Julian* Year of Chriſt 1700 backward; or at the Radix of the *Julian* Year of Chriſt 1701. [See Num. 7. below].

For 5th Operation.

5. In my Fifth Operation, I firſt ſet down the Sun's middle Motion in its Orbit, during the Equation of Time; and the Motion of the Apogæum during the Equation of Time, and the Sum of both theſe Motions.

Next, to the Place of the Apogæum at the End of the Interval of equal Time backward, add the Motion of the Apogæum during the Equation of Time, we have the Sum for the Place of the Apogæum, at the End of the Interval of apparent Time backward [See Num. 7. below].

Next, to Place of Sun's middle Motion under the Ecliptick at the End of the Interval of equal Time backward, add the Sum of both Motions during the Equation of Time, we have the Sum for the Place of the Sun's middle Motion under the Ecliptick, at the End of the Interval of apparent Time backward [See Num. 7. below].

For 6th Operation.

6. In my Sixth Operation, firſt, from the Place of the Sun's middle Motion under the Ecliptick, at the End of the Interval of apparent Time backward, I ſubſtract the Diſtance of the Apogæum Eaſtward from ♈ at the End of the Interval of apparent Time backward; and I ſet down

the Remainder for the mean Anomaly at the End of the Interval of apparent Time backward.

Next, I ſet down the Equation of the Sun's Orbit correſponding to this mean Anomaly, as follows.

Mean Anomaly at the End of the Interval of apparent Time backwards,

$= 6$ Sig. $+ 13^\circ + 04' + 26'' + 11''' + 17''''$

Prime Scruples, *&c.* annexed,

$= 04' + 26'' + 11''' + 17''''$

$= 958277''''$.

Then, by the Reaſoning for the 3d Operation, ſay,

As 1° $(12960000'''')$: Differ. $(427953'''')$: : So the Scruples annexed $(958277'''')$: $31643''''$ $= 8'' + 47''' + 23''''$.

Adding this to the Equation for 6 Sig. $+ 13^\circ$, we have the Sum $= 26' + 27'' + 22''' + 44''''$ for the Equation of the Orbit correſponding to the mean Anomaly $= 6$ Sig. $+ 13^\circ + 04' + 26'' + 11''' + 17''''$.

And becauſe this mean Anomaly $>$ 6 Signs; therefore, adding the Equation of the Orbit to the Place of the Sun's middle Motion under the Ecliptick, at the End of the Interval of apparent Time backward, we have the Sum for the Place of the Sun's apparent Motion at the End of the Interval of apparent Time backward.

Laſtly, I ſet down the Sun's right Aſcenſion at the End of this Interval of apparent Time backward, as follows.

The Difference betwixt the right Aſcenſions of 22° of ♑ and of 21° of ♑ $= 13780793''''$ [as in the Account for 4th Operation]; and the Prime Scruples, *&c.* annexed in the Sun's apparent Place at the End of the Interval of apparent Time backward, are $13' + 51'' + 00''' + 10'''' =$ $991610''''$.

Then, according to the Calculation for 4th Operation, ſay;

As 1 Degree ($12960000''''$): to the Difference ($13780793''''$) :: So the Scruples annexed ($2991610''''$): $3181077'''' = 14' + 43'' + 37'' + 57'''$.

Adding this to the right Aſcenſion of 21° of ♑, we have the Sum $= 9$ Sig $+ 22° + 57' + 21'' + 10''' + 18''''$ for the right Aſcenſion of $21° + 13' + 51'' + 00''' + 10''''$ of ♑, being the Sun's right Aſcenſion at Noon at *Greenwich*, at the Beginning of the 31th aſtronomical Day of *December* (O. S.) at the End of the *Julian* Year of Chriſt 1700, or at the Radix of the *Julian* Year of Chriſt 1701.

1ſt Caſe.

7. Note here, When the Account proceeds backwards, if the aſcenſional Difference be $< \xi ♏ + \frac{\xi}{z}$ (as in this 2d Example, 4th Operation) which is my 1ſt Caſe; then the Equation of the Time is to be ſubſtracted from the equal Time contained in the Interval of Time denominated by $\xi ♏ + \frac{\xi}{z}$ of the Ecliptick, becauſe in this Caſe the Quantity of equal Time denominated by $\xi ♏ + \frac{\xi}{z}$ of the Ecliptick, did exceed the Quantity of apparent Time contained in the Interval which I here denominate by $\zeta ♏ + \frac{\zeta}{z}$ of the Equinoctial, by the Space of equal Time taken up whilſt the Arch $\xi ♏ + \frac{\xi}{z}$ — Arch $\zeta ♏ - \frac{\zeta}{z}$ of the Equinoctial was rolling Weſtward under the Semimeridian of G [Compare the Account in the 4th Operation with Chap. V. Sect. 1. Numbers 4, 6, and 14.].

And in Conſequence of the Subſtraction of this Equation of Time from the equal Time, the Motion of the Apogæum during the Equation of Time muſt be added forward to the Place of the Apogæum at the End of the Interval of equal Time backward; becauſe in this Caſe the Apogæum did not proceed backwards ſo far as is its Motion in ξ ♏ $+ \frac{\xi}{z}$, by its Motion during the Equation of Time: And accordingly ſo I have ſet it down in the Scheme in the 5th Operation.

Alſo, in Conſequence of the Subſtraction of this Equation of Time from the equal Time, the Sum of both Motions, during the Equation of Time, muſt be added forward to the Place of the Sun's middle Motion under the Ecliptick at the End of the Interval of equal Time backward, for the like Reaſon as is given for the Addition of the Motion of the Apogæum forward, during the Equation of Time.

But when the Account proceeds backward, if, 2d Caſe. on the other hand, the aſcenſional Difference be $> \xi$ ♏ $+ \frac{\xi}{z}$, which is my Second Caſe, then the Equation of the Time muſt be added to the equal Time, becauſe in this Caſe the Quantity of equal Time contained in ξ ♏ $+ \frac{\xi}{z}$ of the Ecliptick did come ſhort of the apparent Time contained in ζ ♏ $+ \frac{\zeta}{z}$ of the Equinoctial, by the Space of equal Time taken up whilſt ζ ♏ $+ \frac{\zeta}{z}$ $- \xi$ ♏ $- \frac{\xi}{z}$ was rolling Weſtward under the Semimeridian of G [See Chap. V. Sect. 1. Num. 5, 7, and 14.].

And in Conſequence of the Addition of this Equation of Time to the equal Time, the Motion of the Apogæum during the Equation of Time muſt be ſubſtracted farther backward from the Place of the Apogæum at the End of the Interval of equal Time backward, becauſe in this Caſe, the Apogæum did proceed farther backward (farther contrary to the Order of Signs) than is its Motion in ξ ♏ $+ \frac{\xi}{z}$, by its Motion during the Equation of Time.

Alſo in Conſequence of the Addition of this Equation of Time to the equal Time, the Sum of both Motions, during the Equation of Time, muſt be ſubſtracted farther backward from the Place of the Sun's middle Motion under the Ecliptick at the End of the Interval of the equal Time backward, for the like Reaſon as is given for the Subſtraction of the Motion of the Apogæum during the Equation of Time.

See the Proofs of Particulars in Chap. VI. Sect. 1ſt, 2d Example.

SCHEME, for calculating the Places of the Sun's Apogæum, of the Sun's middle Motion, and of the Sun's apparent Motion under the Ecliptick, and the Sun's right Aſcenſion at Noon at Greenwich, *at the Beginning of the 31ſt aſtronomical Day of* December (O. S.), *at the End of the* Julian *Year of Chriſt* 1700. *at apparent Time.*

Radical Moment.

THE Account begins at Noon at *Greenwich* of apparent Time, at the Beginning of the 14th aſtronomical Day of *July* (O. S.) in the *Julian* Year of Chriſt 1711, which I call my Radical Moment.

So the Account proceeds backward.

And the Interval of apparent Time betwixt thoſe two Noons did contain 10 *Julian* Years $+195$ Days of apparent Time.

Sun's middle Motion in its Orbit 1ſt Operation.
In 195 Days of equal Time backward,
$$=6\text{Sig.}+12^{\circ}+11'+37''+30'''+16''''$$
In 10 *Julian* Years of equal Time backward,
$$=\text{Sig. }11+29^{\circ}+26'+38''+23'''+33''''$$
Motion of Apogæum,
$$\begin{array}{r} 0'+26''+40'''+59'''' \\ 8'+19''+43'''+41'''' \\ \hline 8'+46''+24'''+40'''' \end{array}$$
Sum of middle Motion in Orbit,
$$=6\text{Sig.}+11^{\circ}+38'+15''+53'''+49''''$$
Sum of Motion of Apogæum,
$$=0\text{Sig.}+00^{\circ}+08'+46''+24'''+40''''$$
Sum of both Motions,
$$=6\text{Sig.}+11^{\circ}+47'+02''+18'''+29''''$$
=Sun's middle Motion under the Eclīptick, above the intire Revolutions, in this Interval of equal Time $=\xi\,\text{m}+\frac{\xi}{z}$ [See Chap. V. Sect. 1. Num. 14.]

Place of Apogæum at the radical Moment, 2d Operation.
$$=3\text{Sig.}+07^{\circ}+51'+43''+50'''+48''''$$
Eaſtward from ♈.

Subſtract the Motion of the Apogæum in the Interval of equal Time backward. The Remainder gives

Place of Apogæum at the End of the Interval of equal Time backward,
$$=3\text{Sig.}+07^{\circ}+42'+57''+26'''+08''''$$
Eaſtward from ♈.

Place of Sun's middle Motion at the radical Moment, $=4\text{Sig.}+02^{\circ}+34'+19''+09'''+57''''$ Eaſtward from ♈.

Subſtract $\xi m+\frac{\xi}{z}$ from hence: The Remainder gives

Place of Sun's middle Motion at the End of Interval of equal Time backward,
$=9\text{Sig.}+20^{\circ}+47'+16''+51'''+28''''$ Eaſtward from ♈.

From this ſubſtract the Diſtance of the Apog. Eaſtward from ♈ at the End of the Interval of equal Time backward: Rem. gives

Mean Anom. at the End of Interval of equal Time backward,
$=6\text{Sig.}+13^{\circ}+04'+19''+25'''+20''''$

3d Operation. Equation of Sun's Orbit
$=0\text{Sig.}+00^{\circ}+26'+27''+09'''+20''''$
becauſe mean Anom. $>$ 6 Signs, adding this Equat. to the Sun's middle Motion under the Ecliptick at the End of Interv. of equal Time backward, we have

Sum for the Place of the Sun's apparent Motion at the End of Interv. of equal Time backw. $=9\text{Sig.}+21^{\circ}+13'+44''+00'''+48''''$ Eaſtward fr. ♈, or under $21^{\circ}+13+44+00+48$ of ♑.

4thOperation. Sun's right Aſcenſion at the End of the Interval of equal Time backward,
$=9\text{Sig.}+22^{\circ}+57'+13''+44'''+22''''$,
becauſe right Aſcenſion at the End of Interv. of equal Time backward $>$ right Aſcenſ. at radical Mom. Subſtract this from 12 Signs, we have Remainder
$=2\text{ Sig.}+07^{\circ}+02+46+19+38$

Sun's right Aſcenſion at radical Moment,

$=4+04+02+57+56+22$

Adding the Remainder to the Sun's right Aſcenſion at the radical Mom. we have the Sum, $=6+11+05+44+12+00=$ Aſcenſional Difference at the End of Interv. of equal Time backward.

This aſcenſional Difference is $<\xi$ ♏ $+\frac{\xi}{z}$ by $41^{\prime}+18^{\prime\prime}+06^{\prime\prime\prime}+29^{\prime\prime\prime\prime}$

And the equal Time taken up whilſt this Arch of the Equinoctial was rolling, by the diurnal Motion, under the Semimeridian of G, was 2 min.+44 ſec.+45 th.+21 fou. [by my Table of equal Time taken up, &c.]

This is the Equation of Time, which, becauſe the Account proceeds backward, and becauſe the aſcenſional Difference $<\xi$ ♏ $+\frac{\xi}{z}$, muſt be ſubſtracted from the 10 *Julian* Years + 195 Days of equal Time backward, to give a Remainder = the 10 *Julian* Years + 195 Days of apparent Time betwixt the ſaid two Noons at *Greenwich* [See 2d Example, Num. 7. 1ſt Caſe].

5th Operation.

Sun's middle Motion in Orbit during the Equation of Time

$=\text{Sig. }0+00^{\circ}+00^{\prime}+06^{\prime\prime}+45^{\prime\prime\prime}+58^{\prime\prime\prime\prime}-$

Motion of the Apogæum during the Equation of Time $=\text{Sig. }0+00^{\circ}+00+00+00+01-$

Sum of both Motions during the Equation of Time

$=\text{Sig. }0+00^{\circ}+00+06+45+58+$

To Place of Apog. at End of Interv. of eq. Time backward, add Mot. of Apog. during Equat. of Time, we have the Sum for Place of Apog.

at the End of Interv. of apparent Time backward $=\text{Sig.}\ 3+07^{\circ}+42+57+26+09$ Eaſtward from ♈ [See Num. 7. 1ſt Caſe].

To Place of Sun's middle Motion under the Ecliptick at the End of the Interval of equal Time backward, add Sum of both Motions during the Equat. of Time, we have the Sum for the Place of the Sun's middle Motion under the Ecliptick at the End of Interval of apparent Time backward $=9\ \text{Sig.}+20^{\circ}+47'+23''+37'''+26''''$ Eaſtward from ♈ [See Num. 7. 1ſt Caſe].

6th Operation. From Place of Sun's middle Mot. und. Ecliptick at End of Interv. of appar. Time backward, Subſtract Diſt. of Apogæum Eaſtward from ♈ at End of Interv. of appar. Time backw. we have the Remainder = mean Anomaly at the End of Interval of apparent Time backward

$$=6\ \text{Sig.}+13^{\circ}+\overset{\prime}{04}+\overset{\prime\prime}{26}+\overset{\prime\prime\prime}{11}+\overset{\prime\prime\prime\prime}{17}$$

Equation of Sun's Orbit correſponding

$$=0\ \text{Sig.}+00^{\circ}+26+27+22+44$$

Adding this Equation to Place of Sun's middle Mot. at End of Interv. of appar. Time backward, we have Sum for Place of Sun's apparent Motion at the Interval of apparent Time backward $=9\ \text{Sig.}+21^{\circ}+13+51+00+10$ Eaſtward from ♈, or under

$$21^{\circ}+13'+51''+00'''+10''''\ \text{of}\ ♑.$$

And the Sun's right Aſcenſion at the End of the Interval of apparent Time backward

$$=9\ \text{Sig.}+22^{\circ}+57'+21''+10'''+18''''$$

Namely, at Noon at *Greenwich* at the Beginning of the 31ſt aſtronomical Day of *December* (O. S.), (O.S.), at the Radix of the *Julian* Year of Chriſt 1701, of apparent Time,

For 3d Example.

At Noon at *Greenwich*, at the Radix of the *Julian* Year of Chriſt 1721, of apparent Time,

The Place of the Sun's Apogæum was

3 Sig.+07°+59+37+01+44

The Place of the Sun's middle Motion was

9 Sig.+20°+56+28+14+39

The Place of the Sun's apparent Motion was

9 Sig.+21+22+40+34+10

And the Sun's right Aſcenſion was

$= 9\text{ Sig.} + 23^\circ + 06' + 44'' + 16''' + 38''''$; Each Eaſtward from ♈ [as in the Scheme for the 1ſt Example].

Then beginning an Account at this radical Moment, and proceeding by the Method ſet forth in the Calculations in the 1ſt Example, and obſerving the Rules for determining the aſcenſional Differences, and for comparing the Arches of the Sun's middle Motions under the Ecliptick with the Arches of the aſcenſional Differences ſet forth above [Chap. V. Sect. 1. Num. 13. and 14.], we may find the Places of the Sun's Apogæum, and of the Sun's middle and apparent Motions under the Ecliptick, and the Sun's right Aſcenſion at the End of the Interval of apparent Time forward which may be required.

Places at the Radix of 1741.

And accordingly I have determined theſe Places, and the Sun's right Aſcenſion at the Radix of the *Julian* Year of Chriſt 1741 of apparent Time, which I call my 3d Example.

Namely, at that Moment I have found, that

The Place of the Sun's Apogæum was

$= 3\text{ Sig.} + 08^\circ + 16' + 16'' + 37''' + 20''''$ Eaſtward from ♈, or that the Apogæum was under 8° +16 min.+16 ſec.+37 th.+20 fo. of ♋.

The Place of the Sun's middle Motion under the Ecliptick was $= 9\,\text{Sig.} + 21^\circ + 05' + 33'' + 21''' + 34''''$ Eaſtward from ♈, or under $21^\circ + 05 + 33'' + 21''' + 54''''$ of ♑.

The Place of the Sun's apparent Motion under the Ecliptick was $= 9\,\text{Sig.} + 21^\circ + 31' + 30'' + 36''' + 39''''$ Eaſtward from ♈, or under $21^\circ + 31 + 30 + 36 + 39$ of ♑.

And the Sun's right Aſcenſion was
$9\,\text{Sig.} + 23^\circ + 16 + 07 + 53 + 16$.

For 4th Example. At Noon at *Greenwich*, at the Radix of the *Julian* Year of Chriſt 1701, of apparent Time,

The Place of the Sun's Apogæum was
$3\,\text{Sig.} + 07^\circ + 42' + 57'' + 26''' + 09''''$

The Place of the Sun's middle Motion was
$9 + 20 + 47 + 23 + 37 + 26$

The Place of the Sun's apparent Motion was
$9 + 21 + 13 + 51 + 00 + 10$

And the Sun's right Aſcenſion was
$9 + 22 + 57 + 21 + 10 + 18$

each of them Eaſtward from ♈ [as in the Scheme for the 2d Example].

Then beginning an Account at this radical Moment, and proceeding by the Method ſet forth in the Calculations in the 2d Example; and obſerving the Rules for determining the aſcenſional Differences, and for comparing the Arches of the Sun's middle Motions under the Ecliptick with the Arches of the aſcenſional Differences, ſet forth above [Chap. V. Sect. 1. Num. 13. and 14.], we may find the Places of the Sun's Apogæum and of the Sun's middle and apparent Motions under the Ecliptick, and the Sun's right Aſcenſion, at the End of any Interval of apparent Time backward which may be required.

And

Places at the Radix of 1681

And accordingly I have determined theſe Places, and the Sun's right Aſcenſion at the Radix of the *Julian* Year of Chriſt 1681, of apparent Time, which I call my 4th Example.

Namely, at that Moment I have found, that

The Place of the Sun's Apogæum was 3 Sig.$+07^{\circ}+26'+17''+50'''+33''''$ Eaſtw. fro. ♈, or under $7^{\circ}+26'+17''+50''+33'''$ of ♋.

The Place of the Sun's middle Motion under the Ecliptick was 9 Sig.$+20^{\circ}+38'+19''+00'''+10''''$ Eaſtward from ♈, or under $20^{\circ}+38'$ $38'+19''+00'''+10''''$ of ♑.

The Place of the Sun's apparent Motion under the Ecliptick was 9 Sig.$+21^{\circ}+05'+01''+24'''+20''''$ Eaſtward from ♈, or under $21^{\circ}+05'+01''+24'''+20''''$ of ♑.

And the Sun's right Aſcenſion was $=9$ Sig. $+22^{\circ}+43'+02''+46'''+26''''$.

SECT. II.

I Now proceed to deſcribe a Method for calculating an Ephemeris of the Sun's daily geocentrick Motions throughout the Year, and for ſhewing by how much the apparent Days do orderly exceed or fall ſhort of ſo many Days of equal Time; and alſo for ſhewing if a good Pendulum Clock, going according to equal Time, were ſet by a good Sun-dial at Noon on the 1ſt aſtronomical Day of *Jan.* (O. S.), by how much that Clock would be too faſt or too ſlow on ſeveral ſucceeding Days of the Year.

For theſe Purpoſes, having the Places

Of the Sun's Apogæum

$$=3 \text{ Sig.}+08^{\circ}+16'+16''+37'''+20''''$$

Of the Sun's middle Motion

$$9+21+05+33+21+54$$

Of the Sun's apparent Motion

$$9+21+31+30+36+36$$

Eaſtward from the Beginning of ♈ reſpectively, at Noon at *Greenwich* at the Radix of the *Julian* Year of Chriſt 1741.

And having the Sun's right Aſcenſion at that Moment $=9+23+16+07+53+16$ [as in Sect. 1. for 3d Example];

I begin my Account at this radical Moment; and going on by the Method ſet forth in the Calculations in the 1ſt Example, and obſerving the Rules delivered above [Chap. V. Sect. 1. Num. 13. and 14.], I have in the following Pages determined theſe Places at Noon at *Greenwich* at the Beginning of ſeveral aſtronomical Days (O. S.) in the *Julian* Year of Chriſt 1746. proceeding by Schemes orderly denominated 1ſt, 2d, 3d, and ſo on.

1ſt Scheme. In my 1ſt Scheme I determine the Places at the Beginning of the firſt aſtronomical Day of *January* (at Noon) at the Beginning of the *Julian* Year of Chriſt 1746, of apparent Time.

So the Interval of apparent Time betwixt thoſe two Noons is 5 *Julian* Years + 1 Day.

In my 1ſt Operation I find

The Sun's middle Motions under the Ecliptick, above the entire Revolutions, in that Interval of equal Time $= 00$ Sig. $+00^{\circ}+46'+37''+23'''+22'''' = \xi$ ♏ $+ \frac{\xi}{z}$.

In my 2d Operation I find

The Place of the Apogæum $= 3$ Sig. $+08^{\circ}+20'+26''+37'''+24''''$ Eaſtward from the Beginning of ♈.

And the Place of the Sun's middle Motion $9+21+52'+10''+45'''+16''''$.

And the mean Anomaly 6+13+31′+44″+07‴+52⁗, at the End of the Interval of equal Time forward.

In my 3d Operation I find

The Equation of the Orbit correſponding to that mean Anomaly = 0 Sig. +00°+27′+21″+27‴+56⁗. So we have

The Sun's apparent Place under 22°+19′+32″+13‴+12⁗ of ♑, at the End of the Interval of equal Time forward.

In my 4th Operation I find

The Sun's right Aſcenſion correſponding to the Sun's appar. Place = 9 Sig.+24°+06′+47″+47‴+00⁗;

And the aſcenſional Difference = 0+00+50+39+53+44.

This aſcenſional Difference 7 ξ ♏ + $\frac{\xi}{z}$ by 4′+02″+30‴+22⁗, to which little Arch of the Equinoctial the Equation of Time correſponding 16 Sec.+07 Th.+23 Fou. [by my Table of equal Time taken up, *&c.*], which muſt be added to the Space of equal Time in the 1ſt Operation to give a Sum = thoſe 5 *Julian* Years + 1 Day of apparent Time; becauſe the aſcenſional Difference 7 ξ ♏ + $\frac{\xi}{z}$.

In my 5th Operation I find, by adding the Motion of the Apogæum; and the Sum of the Sun's middle Motion in its Orbit and of the Apogæum reſpectively; during the Equation of Time, we have

The Place of Apogæum = 3 Sig.+08°+20′+26″+37‴+24⁗, Eaſtward from the Beginning of ♈.

The Sun's middle Motion = 9+21+52+11+25+00, at the End of the Interval of apparent Time forward.

In my 6th Operation I find

The mean Anomaly = 6 Sig. + 13° + 31′ + 44″ + 47‴ + 36⁗.

The Equation of the Orbit correſponding = 0 + 00 + 27 + 21 + 29 + 15. So adding this, *&c.* we have

The Place of the Sun's apparent Motion under 22° + 19′ + 32″ + 54‴ + 15⁗ of ♑ at the End of the Interval of apparent Time forward.

COROLLARY. Hence theſe 5 *Julian* Years + 1 Day of apparent Time were longer than 5 *Julian* Years + 1 Day of equal Time by 16 Sec. + 07 Th. + 23 Fourths, *viz.* by the Equation of Time in the 4th Operation, becauſe the aſcenſional Diffrence > ξ ♏ + $\frac{\xi}{z}$.

2d Scheme.

In my 2d Scheme I ſhew the Places at Noon at *Greenwich* at the Beginning of the 6th aſtronomical Day of *January* (O. S.), in the *Julian* Year of Chriſt 1746. of apparent Time:

So the Interval of apparent Time betwixt my radical Moment and the Noon on the ſaid 6th Day of *January* = 5 *Julian* Years + 6 Days of apparent Time.

In my 1ſt Operation I find

The Sun's middle Motions under the Ecliptick above the entire Revolutions, in that Interval of equal Time = 5° + 42′ + 19″ + 02‴ + 08⁗ = ξ ♏ + $\frac{\xi}{z}$.

In my 2d Operation I find

The Place of the Apogæum = 3 Sig. + 08° + 20′ + 27″ + 37‴ + 20⁗ Eaſtward from the Beginning of ♈.

The Place of the Sun's middle Motion under the Ecliptick $=9$ Signs $+26^{\circ}+47'+52''+24'''+02''''$

And the mean Anomaly $=6$ Sig. $+18^{\circ}+27'+25''+05'''+35''''$, at the End of the Interval of equal Time forward.

In my 3d Operation I find

The Equation of the Sun's Orbit correſponding to the mean Anomaly $=0$ Sig. $+00^{\circ}+36'+59''+53'''+38''''$. So we have

The Sun's apparent Place under $27^{\circ}+24'+52''+17'''+40''''$ of ♑, at the End of the Interval of equal Time forward.

In my 4th Operation I find

The Sun's right Aſcenſion correſpondent to the Sun's apparent Place $=9$ Sig. $+29^{\circ}+29'+16''+42'''+32''''$

And the aſcenſional Difference $=0$ Sig. $+06^{\circ}+13'+08''+49'''+16''''$.

This aſcenſional Difference $>$ ξ♏ $+\frac{\xi}{z}$ by $30'+49''+47'''+08''''$, to which little Arch of the Equinoctial, the Equation of Time correſponding $=2$ min. $+02$ ſec. $+58$ th. $+56$ fourths [by my Table of equal Time taken up.]

This muſt be added to the Space of equal Time in the 1ſt Operation to give a Sum $=$ thoſe 5 *Julian* Years $+$ 6 Days of apparent Time, becauſe the aſcenſional Difference $>$ ξ♏ $+\frac{\xi}{z}$.

In my 5th Operation I find

By adding the Motion of the Apogæum, and the Sum of the Sun's middle Motion in its Orbit and of the Apogæum reſpectively, during the Equation of Time, we have,

The Place of the Apogæum $=3$ Sig. $+08^{\circ}+20'+27''+18'''+28''''$ Eaſtward from the Beginning of ♈.

The Place of the Sun's middle Motion $=9$ Sig. $+26^\circ+47'+57''+27'''+05''''$ at the End of the Interval of apparent Time forward.

In my 6th Operation I find

The mean Anomaly $=6$ Signs $+18^\circ+27'+30''+08'''+37''''$

The Equation of the Orbit correſponding $=0$ Sig. $+00^\circ+37'+00''+03'''+22''''$. So adding this, &c. we have

The Place of the Sun's apparent Motion under $27^\circ+24'+57''+30'''+27''''$ of ♑, at the End of the Interval of apparent Time forw.

1ſt COROLL. Hence theſe 5 *Julian* Years + 6 Days of apparent Time were longer than 5 *Julian* Years + 6 Days of equal Time by 2 min. + 02 ſec. + 58 th. + 56 fourths, *viz.* by the Equation of Time in the 4th Operation, becauſe the aſcenſional Difference $> \xi$ ♏ $+ \frac{\xi}{2}$.

Then from this Equation of Time
$=2'+02''+58'''+56''''$

Subſtracting the Equation of Time found in the 1ſt Scheme, 4th Operation
$=0'+16''+07'''+23''''$

We have the Rem. $=1'+46''+51'''+33''''$, which is the equal Time by which the 5 apparent Days betwixt Noon on the 1ſt aſtronomical Day of *January* and Noon on the 6th aſtronomical Day of *January* (O. S.) in the ſaid Year 1746, were longer than 5 Days of equal Time.

2d COROLL. Hence if a good Pendulum Clock, going according to equal Time, were ſet by a good Sun Dial at Noon on the 1ſt aſtronomical Day of *January* (O. S.); then at Noon on *January* the 6th next following, that Clock would be too faſt by 1 min. + 46 ſec. + 51 th. + 33 fou. of equal Time.

3d Scheme.

In my 3d Scheme I ſhew the Places at Noon at *Greenwich*, at the Beginning of the 11th aſtronomical Day of *January* (O. S.) in the *Julian* Year of Chriſt 1746 of apparent Time.

So the Interval of apparent Time betwixt my radical Moment and the Noon on the ſaid 11th Day of *January* = 5 *Julian* Years + 11 Days of apparent Time.

In my 1ſt Operation I find

The Sun's middle Motions under the Ecliptick above the entire Revolutions, in that Interval of equal Time $= 10^\circ + 38' + 00'' + 40''' + 52''''$ $= \xi$ ♏ $+ \frac{\xi}{z}$.

In my 2d Operation I find

The Place of the Apogæum = 3 Sig. $+ 08^\circ + 20' + 27'' + 59''' + 30''''$ Eaſtward from the Beginning of ♈.

The Place of the Sun's middle Motion under the Ecliptick = 10 Sig. $+ 01^\circ + 43' + 34'' + 02''' + 46''''$

And the mean Anomaly = 6 Sig. $+ 23^\circ + 23' + 06'' + 03''' + 16''''$, at the End of the Interval of equal Time forward.

In my 3d Operation I find

The Equation of the Sun's Orbit correſponding to the mean Anomaly 0 Sig. $+ 00^\circ + 46' + 27'' + 54''' + 09''''$. So we have

The Sun's apparent Place under $02^\circ + 30' + 01'' + 56''' + 55''''$ of ♒, at the End of the Interval of equal Time forward.

In my 4th Operation I find

The Sun's right Aſcenſion correſpondent to the Sun's apparent Place $= 10$ Sig. $+04^\circ+47'+01''+17'''+02''''$

And the aſcenſional Difference $= 00$Sig. $+11^\circ+30'+53''+23'''+46''''$

This aſcenſional Difference $> \xi$ ♏ $+ \frac{\xi}{2}$ by $52'+52''+42'''+54''''$, to which little Arch of the Equinoctial, the Equation of Time correſponding $= 3$ min. $+ 30$ ſec. $+56$ th. $+ 13$ fou. [by my Table of equal Time taken up, &c.] which muſt be added to the Space of equal Time in the 1ſt Operation, to give a Sum $=$ thoſe 5 *Julian* Years, and 11 Days of apparent Time, becauſe the aſcenſional Difference $> \xi$ ♏ $+ \frac{\xi}{2}$.

In my 5th Operation I find

By adding the Motion of the Apogæum, and the Sum of the Sun's middle Motion in its Orbit and of the Apogæum reſpectively, during the Equation of Time, we have

The Place of the Apogæum $= 3$ Sig. $+08^\circ 20'+27''+59'''+31''''$ Eaſtward from the Beginning of ♈.

And the Sun's middle Motion $= 10$Sig. $+01^\circ+43'+42''+42'''+32''''$, at the End of the Interval of apparent Time forward.

In my 6th Operation I find

The mean Anomaly $= 6$ Signs $+ 23^\circ+23'+14''+43'''+01''''$

The Equation of the Orbit correſpondent $=0$Sig. $+00^\circ+46'+28''+08'''+32''''$. So adding this, &c. we have

The Place of the Sun's apparent Motion under $02^{\circ} + 30' + 10'' + 51''' + 04''''$ of ♒, at the End of the Interval of apparent Time forward.

1ſt Corollary.

1ſt COROLL. Hence theſe 5 *Julian* Years + 11 Days of apparent Time were longer than 5 *Julian* Years + 11 Days of equal Time, by 3 min. 30 ſec. 56 th. 13 fou. *viz.* by the Equation of Time in the 4th Operation, becauſe the aſcenſional Difference $> \xi$ ♏ $+ \frac{\xi}{z}$.

Then from this Equation of Time = 3 min. 30 ſec. 56 th. 13 fourths, ſubſtracting the Equation of Time found in the 1ſt Scheme, 4th Operation, 0 min. 16 ſec. 07 th. 23 fourths, we have the Remainder 3 min. 14 ſec. 48 th. 50 fourths, which is the equal Time by which the 10 apparent Days betwixt the ſaid Noon on the 1ſt aſtronomical Day of *January* and Noon on the 11th aſtronomical Day of *January* (O. S.) in the ſaid Year 1746, were longer than 10 Days of equal Time.

2d Corollary.

2d COROL. Hence if a good Pendulum Clock, going according to equal Time, were ſet by a good Sun-dial at Noon on the 1ſt Day of *January* (O. S.), then at Noon on *January* the 11th next following, that Clock would be too faſt by 3 min. 14 ſec. 48 th. 50 fou. of equal Time.

Again, from the Equation of Time in the 3d Scheme, 4th Operation 3 min. 30 ſec. 56 thirds, 13 fourths, ſubſtracting The Equation of Time in 2d Scheme, 4th Operation 2 min. 02 ſec. 58 th. 56 fourths, we have the Remainder 1 min. 27 ſec. 57 th. 17 fou. Which is the equal Time, by which the 5 apparent Days betwixt Noon on the ſaid *January* 6th, and Noon on the ſaid *January* 11th, were longer than 5 Days of equal Time.

3d Corollary. 3d COROL. Hence the 5 apparent Days betwixt Noon on the ſaid *January* the 6th, and Noon on the ſaid *January* the 11th, were ſhorter than the 5 apparent Days betwixt Noon on the ſaid *January* the 1ſt and the ſaid *January* the 6th, by 18 ſec. 54 th. 16 fou. equal Time.

For the 5 apparent Days betwixt the ſaid *January* the 1ſt and the ſaid *January* the 6th were longer than 5 Days of equal Time, by 1 min. 46 ſec. 51 th. 33 fou. of equal Time [2d Scheme, 1ſt Corollary]. But the 5 apparent Days betwixt Noon on the ſaid *January* the 6th, and Noon on the ſaid *January* the 11th, were longer than 5 Days of equal Time, by no more than 1 min. 27 ſec. 57 th. 17 fourths of equal Time: Therefore ſubſtracting this leſſer Quantity out of the greater Quantity, we have the Remainder 18 ſec. 54 th. 16 fourths of equal Time, for the Difference by which the 5 apparent Days in the latter Space of Time were ſhorter than the 5 apparent Days in the former Space of Time. And conſequently the apparent Days forward from the ſaid 6th Day of *January* were decreaſing.

4th Scheme. In my 4th Scheme I ſhew the Places at Noon at *Greenwich*, at the Beginning of the 16th aſtronomical Day of *January* (O. S.) in the *Julian* Year of Chriſt 1746 of apparent Time.

So the Interval of apparent Time betwixt my radical Moment and the Noon on the ſaid 16th of *January* was 5 *Julian* Years + 16 Days of apparent Time.

In my 1ſt Operation I find

The Sun's middle Motions under the Ecliptick, above the intire Revolutions, in that Interval of equal Time, $=15^{\circ}+33'+42''+19'''+36''''=\xi$ ♏ $+\frac{\xi}{z}$.

In my 2d Operation I find

The Place of the Apogæum $=3$ Sig. $+08^{\circ}+20'+28''+40'''+33''''$ Eaſtward from the Beginning of ♈.

The Place of the Sun's middle Motion under the Ecliptick $=10$ Sig. $+06^{\circ}+39'+15''+41'''+30''''$.

And the mean Anomaly $=6$ Sig. $+28^{\circ}+18'+47''+00'''+57''''$, at the End of the Interval of equal Time forward.

In my 3d Operation I find

The Equation of the Sun's Orbit correſponding to the mean Anomaly $=0$ Sig. $+00^{\circ}+55'+19''+19'''+39''''$. So we have

The Sun's apparent Place under $7^{\circ}+34'+35''+01'''+09''''$, of ♒, at the End of the Interval of equal Time forward.

In my 4th Operation I find

The Sun's right Aſcenſion correſpondent to the apparent Place $=10$ Sig. $+09^{\circ}+59'+36''+58'''+14''''$.

And the aſcenſional Difference $=00$ Sign $+16^{\circ}+43'+29''+04'''+58''''$.

This aſcenſional Difference $\succ \xi$ ♏ $+\frac{\xi}{z}$ by $1^{\circ}+09'+46''+45'''+22''''$, to which little Arch of the Equinoctial, the Equation of Time correſponding $=4$ min. 38 ſec. 21 th. 18 fou. [by my Table of equal Time taken up, *&c.*] which muſt be added to the Space of equal Time in the 1ſt Operation, to give a Sum $=$ thoſe 5 *Julian*

Years + 16 Days of apparent Time, becauſe the aſcenſional Difference $> \xi\,\text{♏} + \frac{\xi}{z}$.

In my 5th Operation I find

By adding the Motion of the Apogæum; and the Sum of the Sun's middle Motion in its Orbit and of the Apogæum reſpectively; during the Equation of Time, we have

The Place of the Apogæum $= 3\text{ Sig.} + 08^{\circ} + 20' + 28'' + 40''' + 35''''$ Eaſtward from ♈.

And the Sun's middle Motion $= 10\text{ Sig.} + 06^{\circ}\ 39' + 27'' + 07''' + 24''''$ at the End of the Interval of apparent Time forward.

In my 6th Operation I find

The mean Anomaly $= 6\text{ Sig.} + 28^{\circ} + 18' + 58'' + 26''' + 49''''$.

The Equation of the Orbit correſpondent $= 0\text{ Sig.} + 00^{\circ} + 55' + 10'' + 53''' + 04''''$.

Adding this to the middle Motion,

We have the Place of the Sun's apparent Motion under $7^{\circ} + 34' + 38'' + 00''' + 28''''$ of ♒ at the End of the Interval of apparent Time forward.

1ſt Corollary.

1ſt COROLL. Hence theſe 5 *Julian* Years and 16 Days of apparent Time were longer than 5 *Julian* Years and 16 Days of equal Time by 4 min. 38 ſec. 21 th. 18 fourths, *viz.* by the Equation of Time in the 4th Operation, becauſe the aſcenſional Difference is $> \xi\,\text{♏} + \frac{\xi}{z}$.

Then from this Equation of Time = 4 min. 38 ſec. 21 th. 18 fou.

Subſtracting the Equation of Time found in the 1ſt Scheme 4th Operation = 0 min. 16 ſec. 07 th. 23 fou.

We have the Remainder 4 min. 22 ſec. 13 th. 55 fourths, which is the equal Time by which the 15 apparent Days betwixt Noon on the ſaid *January* 1ſt and Noon on the ſaid *January* 16th of apparent Time in the ſaid Year 1746 were longer than 15 Days of equal Time.

2d Corollary.

2d COROLL. Hence if a good Pendulum Clock, going according to equal Time, were ſet by a good Sun-dial at Noon on the 1ſt aſtronomical Day of *January* (O. S.), Then at Noon on *January* the 16th next following, that Clock would be too faſt by 4 min. 22 ſec. 13 th. 55 fou.

Again, from the Equation of Time in the 4th Operation = 4 min. 38 ſec. 21 th. 18 fourths, ſubſtracting

The Equation of Time in 3d Scheme, 4th Operation = 3 min. 30 ſec. 56 th. 13 fourths, we have

The Remainder = 1 min. 7 ſec. 25 th. 05 fou. which is the equal Time by which the 5 apparent Days betwixt Noon on the ſaid *January* the 11th and Noon on the ſaid *January* the 16th were longer than 5 Days of equal Time.

3d Corollary.

3d COROLL. Hence the 5 apparent Days betwixt Noon on the ſaid *January* the 11th and Noon on the ſaid *January* 16th were ſhorter than the 5 apparent Days betwixt Noon on the ſaid *January* the 6th and Noon on the ſaid *January* the 11th by 20 ſec. 32 th. 12 fou.

For the 5 apparent Days betwixt the ſaid *January* the 6th and the ſaid *January* the 11th were longer than 5 Days of equal Time by 1 min. 27 ſec. 57 th. 17 fou. of equal Time [3d Scheme 2d Corollary]. But the 5 apparent Days betwixt the ſaid *January* 11th and the ſaid *January* the 16th were longer than 5 Days of equal Time, by no more than 1 min. 07 ſec.

25th. 5 fourths of equal Time; therefore ſubſtracting this leſſer Quantity out of the greater Quantity, we have the Remainder = 20 ſec. 32 th. 12 fou. of equal Time, for the Difference by which the 5 apparent Days in the latter Space of Time were ſhorter than the 5 apparent Days in the former Space of Time. And conſequently the apparent Days forward from the ſaid 11th Day of *January* were decreaſing yet more.

In my 5th Scheme I ſhew the Places at Noon at *Greenwich* at the Beginning of the 21ſt aſtronomical Day of *January* (O. S.) in the *Julian* Year of Chriſt 1746 of apparent Time.

So the Interval of apparent Time betwixt my radical Moment and the Noon on the ſaid 21ſt of *January* was 5 *Julian* Years and 21 Days of apparent Time.

Then proceeding as in the 4th Scheme, in the 2d Operation, we have the mean Anomaly = $7\text{ Sig.}+03^{\circ}+14'+27''+58'''+40''''$ at the End of Interval of equal Time forward.

And in the 3d Operation we have the Equation of the Orbit correſpondent = 0 Sig. 01° 03 min. 51 ſec. 00 th. 38 fourths.

And in the 4th Operation we have the aſcenſional Difference = 0 Sig. 21° 50 min. 36 ſec. 43 th. 47 fourths.

And the Equation of Time, to be added to the Interval of equal Time = 5 min. 23 ſeconds 57 th. 49 fourths.

In the 5th Operation we have the Place of the Apogæum at the End of the Interval of apparent Time forward = 3 Sig. 08° 20 min. 29 ſe. 21 th. 38 fou.

And in the 6th Operation we have the mean Anomaly = 7 Sig. 03° 14 min. 41 ſec. 16 th. 55 fourths, at the End of the Interval of apparent Time forward.

And the Equation of the Orbit correſpondent =0 Sig. 01° 03 min. 51 ſec. 22 th. 57 fou.

Adding this to the middle Motion, we have the Place of the Sun's apparent Motion under 12° 39 min. 02 ſec. 01 th. 30 fourths of ♒, at Noon at *Greenwich*, at the Beginning of the 21ſt aſtronomical Day of *January* (O. S.) in the *Julian* Year of Chriſt 1746 of apparent Time.

1ſt Corollary.

1ſt Coroll. Hence theſe 5 *Julian* Years and 21 Days of apparent Time were longer than 5 *Julian* Years + 21 Days of equal Time by 5 minutes 23 ſec. 57 th. 49 fou. of equal Time, *viz.* by the Equation of Time in the 4th Operation, as in the 4th Scheme.

Then from this Equation of Time = 5 min. 23 ſec. 57 th. 49 fou. ſubſtracting

The Equation of Time found in 1ſt Scheme 4th Operation = 0 min. 16 ſec. 07 th. 23 fou. we have the Rem. 5 min. 07 ſec. 50 th. 26 fou. which is the equal Time by which the 20 apparent Days betwixt the ſaid Noon on the 1ſt aſtronomical Day of *January* and Noon on the ſaid 21ſt aſtronomical Day of *January* in the ſaid Year of Chriſt 1746, were longer than 20 Days of equal Time.

2d Corollary.

2d Coroll. Hence if a good Pendulum Clock, going according to equal Time, were ſet by a good Sun-dial at Noon on the ſaid 1ſt of *January*, Then at Noon on *January* the 21ſt next following that Clock would be too faſt by 5 minutes 07 ſec. 50 th. 26 fou. of equal Time.

Again, from the Equation of Time in the 4th Operation = 5 min. 23 ſec. 57 th. 49 fourths, ſubſtracting the Equation of Time in the 4th Scheme, 4th Operation = 4 min. 38 ſec. 21 th. 18 fourths, we have the Remainder 0 min. 45 ſeconds, 36 th. 31 fourths, which is the equal Time by which the 5 apparent Days betwixt Noon on the ſaid *January* 16th and Noon on the ſaid *January* the 21ſt were longer than 5 Days of equal Time.

3d Corollary. 3d COROLL. Hence the 5 apparent Days betwixt Noon on the ſaid *January* the 16th and Noon on the ſaid *January* the 21ſt were ſhorter than the 5 apparent Days betwixt Noon on the ſaid 11th Day of *January* and Noon on the ſaid 16th of *January* by 21 ſec. 48 th. 34 fourths of equal Time.

For the 5 apparent Days betwixt the ſaid *January* the 11th and the ſaid *January* the 16th were longer than 5 Days of equal Time by 1 m. 07 ſec. 25 th. 05 fou. [4th Scheme 2d Corollary]. But the 5 apparent Days betwixt the ſaid *January* the 16th and the ſaid *January* the 21ſt were longer than 5 Days of equal Time by no more than 45 ſec. 36 th. 31 fou. of equal Time.

Therefore, ſubſtracting this leſſer Quantity out of the greater Quantity, we have the Remainder = 21 ſec. 48 th. 34 fou. of equal Time, for the Difference by which the 5 apparent Days in the latter Space of Time were ſhorter than the 5 apparent Days in the former Space of Time. And conſequently the apparent Days forward from the ſaid 16th Day of *January* were decreaſing yet more again.

In my 6th Scheme I ſhew the Places at Noon at *Greenwich* at the Beginning of the 26th aſtronomical Day of *January* (O. S.) in the *Julian* Year of Chriſt 1746 of apparent Time.

So the Interval of apparent Time betwixt my ſaid radical Moment and the Noon on the ſaid 26th Day of *January* was 5 *Julian* Years and 26 Days of apparent Time.

Then proceeding as in the 4th Scheme, in the 2d Operation, we have the mean Anomaly $= 7$ Sig. $+08^{\circ}+10'+08''+56'''+21''''$ at the End of equal Time forward.

And in the 3d Operation we have the Equation of the Orbit correſponding $= 0$ Sig. $+01^{\circ}+11'+52''+40'''+39''''$.

And in the 4th Operation we have the aſcenſional Difference $= 00$ Sign $+26^{\circ}+53'+31''+00'''+20''''$.

Equation of Time.

And the Equation of Time to be added at the End of the Interval of equal Time $= 5$ minutes 52 ſec. 27 th. 39 fourths, which is the Equation of Time, and muſt be added to the 5 *Julian* Years and 26 Days of equal Time, to give a Sum equal to thoſe 5 *Julian* Years and 26 Days of apparent Time, becauſe the aſcenſional Difference is $> \xi$ ♏ $\frac{\xi}{z}$ [as in 1ſt Example Sect. 1. Num. 7. 1ſt Caſe].

In my 5th Operation we have the Place of the Apogæum at the End of the Interval of apparent Time forward $= 3$ Sig. $+08^{\circ}+20'+30''+02'''+41''''$ Eaſtward from ♈.

And in the 6th Operation we have the mean Anomaly at the End of the Interval of apparent Time forward $= 7$ Sig. $+08^{\circ}+10'+23''+24'''+49''''$.

And the Equation of Orbit correſponding $=$ 0 Sig. $+01^\circ+11'+53''+03'''+19''''$

Then the Sun's middle Motion being $=$ 10 Sig. $+16^\circ+30'+53''+27'''+30''''$ Eaſtw. from ♈, [in 5th Operation];

The Sum of theſe two gives the Place of the Sun's apparent Motion under $17^\circ+42'+46''+30'''+49''''$ of ♒, at Noon at *G*, at the Beginning of the 26th aſtronomical Day of *January* (O. S.) in the *Julian* Year of Chriſt 1746 of apparent Time.

1ſt Corollary. 1ſt COROL. Hence theſe 5 *Julian* Years and 26 Days of apparent Time were longer than 5 *Julian* Years and 26 Days of equal Time by 5 min. 52 ſec. 27 th. 39 fou. of equal Time, *viz.* by the Equation of Time in the 4th Operation, as in the 4th Scheme.

Then from this Equation of Time $=$ 5 min. 52 ſec. 27 th. 39 fourths, ſubſtracting the Equation of Time in the 1ſt Scheme 4th Operation 16 ſec. 7 th. 23 fourths, we have the Remainder $=5'+36''+20'''+16''''$, which is the equal Time by which the 25 apparent Days betwixt the ſaid Noon on the ſaid 1ſt aſtronomical Day of *January*, and Noon on the ſaid 26th aſtronomical Day of *January* in the ſaid Year of Chriſt 1746 were longer than 25 Days of equal Time.

2d Corollary. 2d COROL. Hence if a good Pendulum Clock, going according to equal Time, were ſet by a good Sun-dial at Noon on the ſaid 1ſt of *January*, then at Noon on *January* the 26th next following, that Clock would be too faſt by 5 min. 36 ſec. 20 th. 16 fou. of equal Time.

Again, from the Equation of Time found in the 4th Operation = 5 min. 52 ſec. 27 th. 39 fourths, ſubſtracting

The Equation of Time found in 5th Scheme, 4th Operation = 5 min. 23 ſec. 57 th. 49 fou. we have

The Remainder = 0 min. 28 ſec. 29 thirds, 50 fourths, which is the equal Time by which the 5 apparent Days betwixt Noon on the ſaid 21ſt of *January* and Noon on the ſaid 26. of *January* were longer than 5 Days of equal Time.

3d Corollary.

3d Corol. Hence the 5 apparent Days betwixt Noon on the ſaid *January* the 21ſt and Noon on the ſaid *January* the 26th were ſhorter than the 5 apparent Days betwixt Noon on the ſaid 16th Day of *January* and Noon on the ſaid 21ſt Day of *January* by 17 ſec. 6 th. 41 fou. of equal Time.

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For the 5 apparent Days betwixt the ſaid *January* the 16th and the ſaid *January* the 21ſt were longer than 5 Days of equal Time by 45 ſec. 36 th. 31 fou. [5th Scheme, 2d Corollary]; but the 5 apparent Days betwixt the ſaid *January* the 21ſt and the ſaid *January* the 26th were longer than 5 Days of equal Time by no more than 28 ſec. 29 th. 50 fourths of equal Time: Therefore ſubſtracting this leſſer Quantity out of the greater Quantity, we have the Remainder = 17 ſec. 06 th. 41 fourths of equal Time, for the Difference by which the 5 apparent Days in this latter Space of Time were ſhorter than the 5 apparent Days in the former Space of Time.

And conſequently the apparent Days forward from the 21ſt Day of *January* above-ſaid were decreaſing yet more again.

In my 7th Scheme I ſhew the Places at Noon at *Greenwich* at the Beginning of the 1ſt aſtronomical Day of *February* (O. S.) in the *Julian* Year of Chriſt 1746 of apparent Time.

So the Interval of apparent Time betwixt my ſaid radical Moment and the Noon on the ſaid 1ſt Day of *February* was 5 *Julian* Years and 32 Days of apparent Time.

Then proceeding as in the 4th Scheme,

In the 2d Operation we have the mean Anomaly $= 7$ Sig. $14^{\circ}+04'+58''+05'''+36''''$ at the End of the equal Time forward.

In the 3d Operation we have the Equation of the Orbit correſponding $= 0$ Sig. $+01^{\circ}+20'+45''+25'''+41''''$.

In the 4th Operation we have the aſcenſional Difference $= 1$ Sig. $+02^{\circ}+49'+47''+05'''+46$.

Equation of Time.

And the Equation of Time to be added at the End of the Interval of equal Time forward 5 min. 58 ſec. 27 th. 08 fourths, which muſt be added to the 5 *Julian* Years and 32 Days of equal Time to give a Sum equal to thoſe 5 *Julian* Years and 32 Days of apparent Time, becauſe the aſcenſional Difference $\triangleright \xi\,\mathfrak{m} + \frac{\xi}{2}$ [as in Sect. 1. 1ſt Ex. Num. 7. 1ſt Caſe].

In my 5th Operation we have the Place of the Apogæum at the End of the Interval of apparent Time forward $= 3$ Sig. $+08^{\circ}+20'+30''$ $51'''+57''''$ Eaſtward from ♈.

In the 6th Operation we have the mean Anomaly at the End of Interval of apparent Time forward $= 7$ Sig. $+14^{\circ}+05'+12''+48'''+50''''$

And the Equation of the Orbit correſponding $= 0$ Sig. $+01^{\circ}+20'+45''+46'''+31''''$.

Then the Sun's middle Motion being $=10\text{Sig.}+22^{\circ}+25'+43''+40'''+47''''$ [in 5th Operation], Eaſtward from ♈.

The Sum of theſe two gives the Place of the Sun's apparent Motion under $23^{\circ}+46'+29''+27'''+18''''$ of ♒, at Noon at *G*, at the Beginning of the 1ſt aſtronomical Day of *February* (O. S.) in the *Julian* Year of Chriſt 1746 of apparent Time.

1ſt Corollary.

1ſt COROL. Hence theſe 5 *Julian* Years and 32 Days of apparent Time were longer than 5 *Julian* Years and 32 Days of equal Time by 5 min. 58 ſec. 27 th. 08 fourths of equal Time, *viz.* by the Equation of Time in the 4th Operation, as in 4th Scheme.

Then from this Equation of Time = 5 min. 58 ſec. 27 th. 08 fourths, ſubſtracting the Equation of Time in 1ſt Scheme, 4th Operation, = 0 min. 16 ſec. 07 th. 23 fourths, we have

The Remainder = 5 min. 42 ſec. 19 thirds, 45 fourths, which is the equal Time by which the 31 apparent Days betwixt the ſaid Noon on the ſaid 1ſt Day of *January* and Noon on the ſaid 1ſt Day of *Februnry* were longer than 31 Days of equal Time.

2d Corollary.

2d COROL. Hence if a good Pendulum Clock, going according to equal Time, were ſet by a good Sun-dial at Noon on the ſaid 1ſt of *January*, then at Noon on the ſaid 1ſt of *February* next following, that Clock would be too faſt by 5 min. 42 ſec. 19 th. 45 fou. of equal Time.

Again, from the Equation of Time found in 4th Operation = 5 min. 58 ſec. 27 th. 08 fou. ſubſtract

The Equation of Time found in 6th Scheme, 4th Operation = 5 min. 52 ſec. 27 th. 39 fou. we have

The Remainder 0 min. 05 ſec. 59 th. 29 fou. which is the equal Time by which the 6 apparent Days betwixt Noon on the ſaid 26th of *January* and Noon on the ſaid 1ſt Day of *February* were longer than 6 Days of equal Time.

3d Corollary. 3d COROL. Hence the Exceſs of the 6 apparent Days betwixt Noon on the ſaid 26th of *January* and Noon on the ſaid 1ſt of *February*, above 6 Days of equal Time, was leſs than the Exceſs of the 5 apparent Days betwixt Noon on the ſaid 21ſt of *January* and Noon on the ſaid 26th Day of *Janury*, above 5 Days of equal Time.

For the 5 apparent Days betwixt Noon on the ſaid 21ſt of *January* and Noon on the ſaid 26th of *January* were longer than 5 Days of equal Time by 28 ſec. 29 th. 50 fou. [6th Sch. 2d Corollary] ; but the 6 apparent Days betwixt Noon on the ſaid 26th of *January* and Noon on the ſaid 1ſt of *February*, were longer than 6 Days of equal Time by no more than 5 ſec. 59 th. 29 fou. of equal Time ; therefore ſubſtracting this leſſer Quantity out of the greater Quantity of equal Time, we have the Remainder = 22 ſec. 30 th. 21 fou. of equal Time, for the Difference by which the Exceſs of the 6 apparent Days above 6 equal Days in this latter Space of Time was leſs than the Exceſs of the 5 apparent Days above 5 equal Days in the former Space of Time.

And conſequently the 6 apparent Days forward from Noon on the ſaid 26th Day of *January* were decreaſing yet more.

In like Manner, by proceeding to find by Calculation the Sun's apparent Places at Noon at the Beginning of the 1ſt, the 6th, the 11th, the 16th, the 21ſt, and the 26th aſtronomical Days of each ſucceeding Month of the Year, we lay the Foundation of calculating an Ephemeris of the daily geocentric Motions of the Sun throughout the *Julian* Year of Chriſt 1746.

The like may be ſaid of any other *Julian* year of Chriſt.

Then for aſſigning the Sun's apparent Place at Noon on each intermediate aſtronomical Day of the ſaid Month of *January*,

1. Call the Sun's apparent Place as found by Calculation at Noon on the Num. 1.

1ſt	Aſtronomical Day of *January*	=A
6th		=B
11th		=C
16th		=D
21ſt		=E
26th		=F

Call the Arch of the Ecliptick

=B—A=5a
=C—B=5b
=D—C=5c
=E—D=5d
=F—E=5e

Call the Sun's apparent Place at Noon on the 1ſt aſtronomical Day of *February* next following =2d A.

Then becauſe there are 6 intermediate Days betwixt Noon on the ſaid 26th Day of *January* and Noon on the ſaid 1ſt Day of *February*, I call the Arch of the Ecliptick =2d A—F=6 f.

Note, When in the Month in hand there are 30 Days, then 2d A—F=5 f.

And when in the Month in hand there are 29 Days, then 2d A—F=4 f.

And when in the Month in hand there are 28 Days, then 2d A—F=3 f.

Num. 2. 2. Here B under $27^\circ+24'+57''+30'''+27''''$ of ♑ [2d Sch. 6th Operation].

And A under $22^\circ+19+32+54+15$ of ♑ [1ſt Sch. 6th Operation].

So $B—A=5^\circ+05+24+36+12$ $=65968572''''=5\,a$.

So $a=13193714{,}4''''{,}4=1^\circ+01'+04''+55''$ $+14'''{,}4=a$.

Then to A under $22^\circ+19+32+54+15$ of ♑ on the 1ſt Day

Add a $=$ $1^\circ+01+04+55+14{,}4$

Sum $=$ $23^\circ+20+37+49+29{,}4$ of ♑=apparent Place on 2d Day.

Hereto add a $=$ $1^\circ+01+04+55+14{,}4$

Sum $=$ $24^\circ+21+42+44+43{,}8$ of ♑ =apparent Place on 3d Day

Hereto add a $=$ $1^\circ+01+04+55+14{,}4$

Sum $=$ $25^\circ+22+47+39+58{,}2$ of ♑ =apparent Place on 4th Day

Hereto add a $=$ $1^\circ+01+04+55+14{,}4$

Sum $=$ $26^\circ+23+52+35+12{,}6$ of ♑ =apparent Place on 5th Day

Hereto add a $=1^\circ+01+04+55+14{,}4$

Sum $=$ $27^\circ+24+57+30+27$ of ♑ =apparent Place on 6th Day.

3. Her

3. Here C under $2^\circ+30'+10''+51'''+04''''$ Num. 3. of ♒ [3d Sch. 6th Operation].

And B under $27^\circ+24+57+30+27$ of ♑

So $C-B=5^\circ+05'+13''+20'''+37''''$
$=65928037''''=5$ b.

So $b = 13185607'''',4 = 1^\circ+01'+02''+40'''$
$=07'''',4=b$.

Then to B under $27^\circ+24'+57''+30'''+27''''$ of ♑ on 6th Day

Add b $=$ $1^\circ+01+02+40+07,4$

Sum under $28^\circ+26+00+10+34,4$ of ♑ on 7th Day

Hereto add $b= 1^\circ+01+02+40+07,4$

Sum under $29^\circ+27+02+50+41,8$ of ♑ on 8th Day

Hereto add $b= 1^\circ+01+02+40+07,4$

Sum under $0+28+05+30+49,2$ of ♒ on 9th Day

Hereto add $b = 1+01+02+40+07,4$

Sum under $1+29+08+10+56,6$ of ♒ on 10th Day

Hereto add $b=1+01+02+40+07,4$

Sum under $2+30+10+51+4$ of ♒ on 11th Day.

Num. 4. 4. Here D under $7^\circ+34'+38''+00''+28''''$ of ♒ [4th Sch. 6th Operat.]

And C under $2^\circ+30'+10''+51'''+04''''$ of ♒;

So $D-C=5^\circ+04'+27''+09'''+24'''=5c=65761764''''$

So $c=13152352'''',8=1^\circ+00'+53''+25'''+52'''',8$.

Then to C adding c, and to that Sum adding c, and to that Sum adding c, and to that Sum adding c again, and again adding c to the laſt Sum,

We have the Sun under

$\;^\circ\quad '\quad ''\quad '''\quad ''''$
$3+31+04+16+56{,}8$ of ♒ on the 12th Day
$4+31+57+42+49{,}6$ of ♒ on the 13th Day
$5+32+51+08+42{,}4$ of ♒ on the 14th Day
$6+33+44+34+35{,}2$ of ♒ on the 15th Day
$7+34+38+00+28$ of ♒ on the 16th Day

Num. 5. 5. Here E under $12^\circ+39'+02''+01'''+30''''$ of ♒ [5th Sch. 6th Oper.].

And D under $7^\circ+34'+38''+00'''+28''''$ of ♒.

So $E-D=5^\circ+04'+24''+01'''+02''''=65750462''''=5d$

So $d=13150092'''',4=1^\circ+00'+52''+48'''+12'''',4$.

Then to D adding d, and to that Sum adding d, and to that Sum adding d again, and again to the laſt Sum adding d, We have the Sun under

$^{\circ}\quad {}'\quad {}''\quad {}'''\quad {}''''$

$8+35+30+48+40,4$ of ♒ on 17th Day
$9+36+23+36+52,8$ of ♒ on 18th Day
$10+37+16+25+05,2$ of ♒ on 19th Day
$11+38+09+13+17,6$ of ♒ on 20th Day
$12+39+02+01+30$ of ♒ on 21ſt Day.

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6. Here F under $17^{\circ}+42'+46''+30'''+59''''$ of ♒ [6th Sch. 6th Operat.]. Num. 6.

And E under $12^{\circ}+39'+02''+01'''+30''''$ of ♒.

So $F-E=5^{\circ}+03'+44''+29'''+19''''$ $=65608159''''=5$ e.

So $e=13121631'''',8=1^{\circ}+00'+44''+53'''$ $+51''''8=e$.

Then to E adding e, and to that Sum adding e, and to that Sum adding e again, and again to the laſt Sum adding e,

We have the Sun under

$^{\circ}\quad {}'\quad {}''\quad {}'''\quad {}''''$

$13+39+46+55+21,8$ of ♒ on 22d Day
$14+40+13+49+13,6$ of ♒ on 23d Day
$15+41+16+43+05,4$ of ♒ on 24th Day
$16+42+01+36+57,2$ of ♒ on 25th Day
$17+42+46+30+49$ of ♒ on 26th Day.

7. Here 2d A, under $23^{\circ}+46'+29''+27'''$ $+18''''$ of ♒ [7th Sch. 6th Operat.] Num. 7.

And F under $17^{\circ}+42'+46''+30'''+49''''$ of ♒

So 2d $A-F=6^\circ+03'+42''+56'''+29''''$ $=78562589''''=6f$

So $f=13093764,833$ &c. $=1^\circ+00'+37''$ $+09'''+24'''',833$ &c.$=f$.

Then to F adding f, and to that Sum adding f, and to that Sum adding f again, and again to the laſt Sum adding f,

We have the Sun under

$18^\circ+43'+23''+40'''+13'''',833$ &c. of ♒ on 27th Day of *January*

$19+44+00+49+38,666$ &c. of ♒ on 28th Day of *January*

$20+44+37+59+03,499$ &c. of ♒ on 29th Day of *January*

$21+45+15+08+28,332$ &c. of ♒ on 30th Day of *January*

$22+45+52+17+53,165$ &c. of ♒ on 31ſt Day of *January*

$23+46+29+27+17,998$ &c. of ♒ on 1ſt Day of *February*.

Hereto I ſubjoin a SYNOPSIS of the Sun's Daily Geocentrick apparent Motions, and of the Differences betwixt the Clock and the Sun-dial, throughout the Month of *January*, in the *Julian* Year of Chriſt 1746.

The Days of the Month proceed according to the Old Style.

	SUN's Daily Geocentrick MOTIONS. ☉ in ♑.							
	°	′	″	‴	⁗			
1	22	+19	+32	+54	+15	of ♑	Clock ſet even with ☉	
2	23	20	37	49	29			
3	24	21	42	44	44			
4	25	22	47	39	54			
5	26	23	52	35	13		Clock too faſt by	
6	27	+24	+57	+30	+27		1 mi. 40 ſe. 51 th. 33 f.	3d Sch.
7	28	26	00	10	34			2d Cor.
8	29	27	02	50	42			
9	00	28	05	30	49	of ♒		
10	1	29	08	10	57			
11	2	+30	+10	+51	+04		3 mi. 14 ſe. 48 th. 50 f.	3d Sch.
12	3	31	04	16	57			2d Cor.
13	4	31	57	42	50			
14	5	32	51	08	42			
15	6	33	44	34	35			
16	7	+34	+38	+00	+28		4 mi. 22 ſe. 13 th. 55 f.	4th Sch.
17	8	35	30	48	40			2d Cor.
18	9	36	23	36	53			
19	10	37	16	25	0			
20	11	38	09	13	18			
21	12	+39	+02	+01	+30		5 mi. 07 ſe. 50 th. 26 f.	5th Sch.
22	13	39	46	55	22			2d Cor.
23	14	40	31	49	14			
24	15	41	16	43	04			
25	16	42	1	36	57			
26	17	+42	+46	+30	+49		5 mi. 36 ſe. 20 th. 16 f.	6th Sch.
27	18	43	23	40	14			2d Cor.
28	19	44	00	49	39			
29	20	44	37	59	04			
30	21	45	15	08	28			
31	22	+45	+52	+17	+53			

FE-

FEBRUARY, 1746.

	SUN'S Daily Geocentrick MOTION. ⊙ in ♒.							
	°	′	″	‴	⁗		Clock too faſt by	
1	23	46	29	27	18		5 mi. 42 ſe. 19 th. 45 f.	7th Sch.
2								2d Cor.
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								

I come now to lay down a Method for determining the Moment of apparent Time of the Sun's apparent Ingreſs into any of the Signs, or Points, of the Ecliptick. 3d Sect.

Let it be required to determine the Moment of Time apparent of the Sun's apparent Ingreſs into the Sign ♈, in the *Julian* Year of Chriſt 1746. Preamble.

I begin my Account at the Radix of the *Julian* Year of Chriſt 1741. of apparent Time at *Greenwich*; at which Moment
The Apogæum of the Sun's Orbit was 3 Sig. $08°+16'+16''+37'''+20''''$ Eaſtward from ♈.
The Place of the Sun's middle Motion was 9 Sig. $21°+05+33+21+54$ Eaſtw. from ♈.
The Place of the Sun's appar. Motion was 9 Sig. $21°+31+30+36+39$ Eaſtw. from ♈.
The Sun's right Aſcenſion was 9 Sig. $23°+16+07+53+16$ Eaſtw. from ♈.

1. Betwixt the radical Moment and the Moment of the Sun's apparent Ingreſs into the Sign ♈ in the *Julian* Year of Chriſt 1746, there were 5 tropical Years according to equal Time, and ſo much equal Time over and above as was taken up betwixt the End of the 5 tropical Years and the Moment of the Sun's apparent Ingreſs into the Sign ♈.

Now in 1 tropical Year there are 365 Days 5 Hours 48 Minutes 57 Sec. [Chap. 1. Sect. 2. Num. 2.], or 1 *Julian* Year 5 Hours 48 Min. 57 Sec. So that in 5 tropical Years, by the Addition of 1 Day every 4th Year, there are 5 *Jul.* Years 5 Hours 4 Minutes 45 Sec. And theſe

Years, Hours, *&c.* are to be accounted as of equal Time.

Then the Sun's middle Motion under the Ecliptick in a tropical Year = one entire Revolution of the Sun from ſome one Point of the Ecliptick to the ſame Point of the Ecliptick again [from Chap. I. Sect. 2. Num. 2. and from Sect. 6. Num. 10.].

So that whatſoever Point of the Ecliptick the Sun was under at the Beginning of any Number of tropical Years according to the middle Motion, the ſame Point of the Ecliptick, according to the middle Motion, the Sun will be under at the End of that Number of tropical Years again.

Conſequently, whereas at the Beginning of thoſe 5 tropical Years (whereas at the radical Moment) the Sun was under $21^\circ+05'+33''+21'''+54''''$ of ♑, according to the middle Motion [Preamble] at the End of thoſe 5 *Julian* Years 5 Hours 4 Min. 45 Sec. of equal Time forward, the Sun will be found to be under $21^\circ+05'+33''+21'''+54''''$ of ♑, according to the middle Motion again, or to be diſtant 9 Sig. $+21^\circ+05'+33''+21'''+54''''$ Eaſtward from ♈.

2. Then in thoſe 5 *Julian* Years 5 Hours 4 Min. 45 Sec. the Sun's Apogæum will have moved Eaſtward under the Ecliptick = 4 min. 9 ſec. 53 th. 36 fou.

So adding this to the Place of the Sun's Apogæum at the radical Moment, we have the Sum for the Place of the Sun's Apogæum at the End of thoſe 5 *Julian* Years 5 Hours 4 Minutes

nutes 45 ſec. forward = 3 Sig. 08° 20 min. 26 ſec. 30 th. 56 fourths Eaſtward from ♈, *viz.* at 5 hours 4 min. 45 ſec. of equal Time, on the 31ſt aſtronomical Day of *December* (O. S.) at the End of the *Julian* Year of Chriſt 1745 of equal Time.

So from the Place of the Sun's middle Motion under the Ecliptick, at the radical Moment, *viz.* from 9 Sig. 21° 05 min. 33 ſec. 21 th. 54 fou.

Subſtracting the Place of the Apogæum = 3 Sig. 8° 20 min. 26 ſec. 30 th. 56 fou.

Mean Anomaly.

We have the Remainder = the mean Anomaly at 5 hours 4 min. 45 ſec. of equal Time on the ſaid 31ſt Day of *December* in the ſaid Year 1745 = 6 Sig. 12° 45 min. 06 ſec. 50 th. 58 fourths.

3. Equation of Sun's Orbit correſponding = 0 Sig. 00° 25 min. 48 ſec. 57 th. 15 fourths.

For Equation to 6 Sig. 13° — Equat. to 6 Sig. 12° = 430015 fourths = D.

And the prime Scruples, *&c.* annexed in the mean Anom. = 9744658 fourths.

And as 1° (12960000 fourths) : D (430015 fourths) : : So the Scruples annexed (9744658 fourths) : 323329 fourths = 1 min. 29 ſec. 48 th. 19 fourths;

To this adding the Equation to 6 Sig. 12° = 24 min. 19 ſec. 08 th. 26 fourths;

We have the Sum = 25 min. 48 ſec. 57 th. 15 fourths = Equation correſponding to the mean Anomaly above.

Then becauſe the mean Anomaly > 6 Signs, adding this Equation of the Orbit to the Place of the Sun's middle Motion in Number 1. above;

We have the Sum = 9 Sig. 21° 31 min. 22 ſec. 19 th. 09 fourths Eaſtward from ♈, or un-

Sun's apparent Place at the End of 5 trop. Years.

der 21° 31 min. 22 ſec. 19 th. 09 fourths of ♑ for the Sun's apparent Place at 5 Hours 4 min. 45 ſec. of equal Time on the ſaid 31ſt Day of *December* in the *Julian* Year of Chriſt 1745 [Chap. 4. Sect. 1. Num. 7.].

4. So from the Beginning of the Sign ♈, ſubſtracting the Sun's apparent Place = 21° 31 mi. 22 ſec. 19 th. 09 fourths of ♑, we have the Remainder = 2 Sig. 08° 28 min. 37 ſec. 40 th. 51 fourths = Arch of the Ecliptick under which the Sun moved by its apparent Motion betwixt the 31ſt aſtronomical Day of *December* (O. S.) at 5 Hours 4 min. 45 ſec. of equal Time in the *Julian* Year of Chriſt 1745, and the Moment at which the Sun came to the Beginning of the Sign ♈ in the *Julian* Year of Chriſt 1746, of equal Time at *Greenwich*.

5. Then I find, by my Tables, that whilſt the Sun was paſſing by its middle Motion under the Arch of the Ecliptick = 2 Sig. 08° 28 min. 37 ſec. 40 th. 51 fourths; that is to ſay, during the Space of 69 Days 11 Hours 23 min. nearly, the Apogæum of the Sun's Orbit moved Eaſtward = 9 ſec. 30 th. 25 fou. nearly.

And the Quantity of the Motion of the Apogæum in the Space of Time whilſt the Sun was paſſing under this Arch of the Ecliptick by its middle Motion being inconſiderably different from the Quantity of the Motion of the Apogæum in the Space of Time whilſt the Sun was paſſing under this Arch by its apparent Motion; therefore adding this Motion of the Apogæum to the Place of the Sun's Apogæum at the End of the 5 *Julian* Years 5 hours 4 min. 45 ſec. of equal Time, we have the Sum = 3 Sig. 08°

20 min. 36 ſec. 01 th. 21 fou. Eaſtward from ♈ for the Sun's Apogæum, nearly, at the Moment of equal Time at which the Sun was come by its apparent Motion to the Beginning of the Sign ♈, in the Year 1746.

So ſubſtracting this Place of the Apogæum from the Place of the Sun's apparent Motion at the Moment at which the Sun was come to the Beginning of the Sign ♈, to the Point ♏ of its Orbit in the Angle B T ♏ not exceeding Angle B T ♈, 1ſt Fig. for Ch. IV. Sect. 1. Numbers 3, 4, *&c.* we have the Remainder = 8 Signs 21° 39 min. 23 ſec. 58 th. 39 fourths for the true Anomaly at the Moment of the Sun's comeing to the Beginning of the Sign ♈ of equal Time [In 2d Note ſubjoined to Ch. IV. Sect. 1. Num. 8.].

So the true Anomaly being > 6 Signs, we have the mean Anomaly at that Moment = the true Anomaly — the Equation of the Orbit correſponding thereto [by the Reverſe of Chap. IV. Sect. 1. Num. 7.]

And for finding the mean Anomaly correſponding hereto, by examining my Table of the Equations of the Sun's elliptical Orbit, I find that the mean Anomaly required was > 8 Sig. 19° and < 8 Signs 20°.

For putting the mean Anomaly = 8 Signs 19° 00 min. 00 ſec. 00 th. 00 fourths, we have the Equation of Orbit correſponding = 0 Sign 01° 52 min. 12 ſec. 34 th. 07 fou.

And we have the Sum of theſe = 8 Sig. 20° 52 min. 12 ſec. 34 th. 07 fourths = true Anomaly correſponding to 8 Sig. 19°.

This is < the true Anomaly given by 47 mi. 11 ſec. 24 th. 32 fourths.

And putting the mean Anomaly = 8 Signs 20° 00 min. 00 ſec. 00 th. 00 fourths, we have the Equation of Orbit correſponding 0 Sign 01° 52 min. 30 ſec. 58 th. 05 fourths,

And we have the Sum of theſe 8 Sig. 21° 52 min. 30 ſec. 58 th. 05 fourths = true Anomaly correſponding to 8 Signs 20°.

This is $>$ the true Anomaly given by 13 min. 06 ſec. 59 th. 26 fou.

6. Now in putting the mean Anomaly = 8 Sig. 20°, we have the true Anomaly bigger than it ſhould be by 2833166 fourths, which I call b;

And in putting the mean Anomaly = 8 Sig. 19°, we have the true Anomaly leſs than it ſhould be by 10193072 fourths, which I call a.

And 8 Sig. 20° — 8 Sig. 19° = 12960000 fou. This I call D.

Let D be divided into two Parts, ſo as that a proportional Part of it ſhall correſpond to b, which Part I call x.

So the remaining Part correſponding to a = D — x.

Then ſay, As $b : a :: $ So $x : D-x$. So $ax = bD - bx$.

So $ax + bx = bD$. So $x = \frac{bD}{a+b}$.

Where $bD = 36717831360000$. And $a+b = 13026245$ fourths.

So $\frac{bD}{a+b} = 28.8758$ fou.—13 min. 02 ſec.

x 59 th. 18 fou.— = x.

D—x And D—x = 46 min. 57 ſec. 00 th. 42 fourths = D—x.

So from the bigger mean Anomaly 8 Signs 20° 00 min. 00 ſec. 00 th. 00 fourths.

Subſtracting x = 0 Sig. 00° 13 min. 02 ſec. 59 th. 18 fou.

We have the Remainder = 8 Sig. 19° 46 mi. 57 ſec. 00 th. 42 fou. for the mean Anomaly correſponding to the true Anomaly given above [Num. 5.].

And we have the Equation of the Orbit correſponding to this mean Anomaly = 1° 52 min. 26 ſec. 57 th. 58 fourths, as will be found by a like Proceeding, as is uſed in Num. 3. above.

And adding this Equation to the mean Anomaly = 8 Sig. 19° 46 min. 57 ſec. 00 th. 42 fo. we have the Sum = 8 Sig. 21° 39 min. 23 ſec. 58 th. 40 fourths = nearly to the true Anomaly found above in Num. 5.

Or,

So to the leſſer mean Anomaly 8 Sig. $+ 19^\circ + 00' + 00'' + 00''' + 00''''$,

Adding $D - x = 46' + 57'' + 00''' + 42''''$;

We have the Sum = 8 Sig. $19^\circ\ 46'\ 57''\ 00''\ 42''''$ = the mean Anomaly correſponding to the true Anomaly given above in Num. 5.

To this mean Anomaly, adding the Diſtance of the Apogæum Eaſtward from ♈ at the End of the Interval of equal Time forward = 3 Sig. $+ 08^\circ + 20' + 36'' + 01''' + 21''''$ [Num. 5.],

We have the Sum = 11 Sig. $+ 28^\circ + 07' + 33'' + 02''' + 03''''$ Eaſtw. from the Beginning of the Sign ♈, according to the middle Motion at the Moment of equal Time at which the Sun was come to the 1ſt Point of the Sign ♈, according to its apparent Motion.

Out of this, ſubſtracting the Sun's middle Motion under the Eclíptick, at the End of the 5 tropical Years = 9 Sig. $+ 21^\circ + 05' + 33'' + 21'''$ $54''''$ [Num. 1.];

We have the Remainder = 2 Sig. $+ 07^\circ + 01'$ $59'' + 40''' + 09''''$ = Sun's middle Motion under the Ecliptick in the Interval of equal Time betwixt the End of the 5 tropical Years and the Moment at which the Sun was come to the 1ſt Point of the Sign ♈, according to apparent Motion.

7. Here 2 Sig.$+07^\circ+01'+59''+40'''+09''''$ $=868750809''''$.

And in 365 Days equal Time, Sun's middle Motion in Orbit $=4662324722'''',7958897+$

Mot. of Sun's Apog.$=179803'''',5464483-$ [Chap. IV. Sect. 1. Num. 9.]

So in 365 Days, Sun's middle Motion under Ecliptick$=4662504526,3423380$. Then ſay,

As $4662504526'''',34+$: 365 Days (113529600000 fourths) : : So $868750809''''$: 21153637769 fourths = 68 Days 00 hours 13 min. 30 ſec. 29th. 29 fourths. Then

Adding hereto 00 Days 05 hours 04 m. 45 ſ.

We have the Sum = 68 Days 05 hou. 18 min. 15 ſec. 29 th. 29 fourths for the equal Time taken up betwixt Noon on the Beginning of the 31ſt aſtronomical Day of *December*, at the End of the *Julian* Year of Chriſt 1745 of equal Time, and the Moment of equal Time taken up during 5 Hours 4 min. 45 ſec. and during the Sun's Paſſage Eaſtward by the middle Motion under 2 Sig. $+07^\circ+01'+59''+40'''+09''''$ of the Ecliptick.

And the End of this equal Time forward from Noon on the ſaid 31ſt Day of *December* in the ſaid *Julian* Year of Chriſt 1745, was on the 9th aſtronomical Day of *March* at 5 Hours 18 min. 15 ſec. 29 th. 29 fourths, in the *Julian* Year of Chriſt 1746 of equal Time.

Then becauſe the true Anomaly $>$ 6 Signs [as in Num. 5 above] to the Place of the Sun's middle Motion found above, in Num. 6. at the End of the Interval of equal Time forward = 11 Sig. $+28^{\circ}+07'+33''+02'''+03''''$ Eaſtw. from ♈,

Adding the Equation of the Orbit, in Num. 6, $=00$ Sig. $+01^{\circ}+52'+26''+57'''+58''''$, we have the Sum $=12$ Sig. $+00^{\circ}+00'+00''+00'''+01''''$ Eaſtward from the 1ſt Point of ♈, for the Place of the Sun's apparent Motion on the ſaid 9th Day of *March* at 5 Hours 18 min. 15 ſec. 29 th. 29 fou. of equal Time [Ch. IV. Sect. 1. Num. 7.].

And the Sun's right Aſcenſion correſponding to this apparent Place of the Sun; *viz.* to 30° of ♓ $=12$ Sig. $+00^{\circ}+00'+00''+00'''+00''''$,

And from the right Aſcenſion $=12$ Sig. $+00^{\circ}+00'+00''+00'''+00''''$, ſubſtracting the right Aſcenſion at the radical Moment $=9$ Sig. $+23^{\circ}+16'+07''+53$ th. $+16''''$,

We have the Remainder $=2$ Sig. $+06^{\circ}+43'+52''+06'''+44''''$, which is the aſcenſional Difference [Ch. V. Sect. 1. Num. 13. 1ſt Inſt. 1ſt Caſe].

8. Then working as in Sect. 1. 1ſt Example, 1ſt Operation, I find the Sun's middle Motions under the Ecliptick in the 5 *Julian* Years 68 Days 5 Hours 18 min. 15 ſec. 29 th. 29 fou. of equal Time, to be $=2$ Sig. $+07^{\circ}+02'+59''+40'''+09''''$ above the intire Revolutions; this is ξ ♏ $+\frac{\xi}{z}$. [Ch. V. Sect. 1. Num. 14.]. ξ ♏ $+\frac{\xi}{z}$

Here the aſcenſional Difference $<\xi$ ♏ $+\frac{\xi}{z}$ by $19'+07''+33'''+25'''$. And the equal Time taken up whilſt this Arch of the Equinoctial was rolling Weſtward by the diurnal Motion under the Semimeridian of G was $=1$ min. 16 ſec. 17

th. 42 fou. of equal Time [by my Table of equal Time, *&c.*]

Equation of Time.

This is the Equation of Time, which, becauſe the aſcenſional Difference $\sphericalangle\, \xi$ ♏ $+ \frac{\xi}{z}$, muſt be ſubſtracted from the 9th aſtronomical Day of *March* aforeſaid, at 5 Hours 18 min. 15 ſec. 29 th. 29 fou. of equal Time in the *Julian* Year of Chriſt 1746, to give a Remainder = the 9th aſtronomical Day of *March* (O. S.) at 5 Hours 16 min. 59 ſec. 11 th. 47 fou. of apparent Time at *Greenwich*, in the *Julian* Year of Chriſt 1746, at which Moment of apparent Time the Sun was come to the Beginning of the Sign ♈ according to its apparent Motion [Sect. 1. 1ſt Example, Num. 7. 2d Caſe].

Sun's apparent Ingreſs into the Sign ♈ in 1746.

By the like Method may the Moment of apparent Time be determined of the Sun's apparent Ingreſs into any of the Signs, or Points, of the Ecliptick in its Aſcent from the Perigæum to the Apogæum in any Year, reſpect being had to the 2d and 3d Notes above ſubjoined to Number 8, in Chap. IV. Sect. 1.

2d Example.

Let it be required to determine the Moment of apparent Time of the Sun's Ingreſs into the Sign ♎ in the *Julian* Year of Chriſt 1746.

I begin my Account at the Radix of the *Julian* Year of Chriſt 1741. of apparent Time at *Greenwich*, at which Moment

The Apogæum of the Sun's Orbit was 3 Sig. $+08^{\circ}+16'+16'+37'''+20''''$.

The Place of the Sun's middle Motion was 9 Sig. $+21^{\circ}+05+33+21+54$.

The Place of the Sun's apparent Motion was 9 Sig. $+21^{\circ}+31+30+36+39$, each Eaſtward from ♈ [Sect. 1. 3d Example].

The Sun's right Aſcenſion was $=9$ Sig. $+23^{\circ}+16'+07''+53'''+16''''$.

By the Reaſonings uſed in the firſt three Numbers of the 1ſt Example, at 5 Hours 4 min. 45 ſec. of equal Time, on the 31ſt aſtronomical Day of *December* (O. S.), at the End of the *Julian* Year of Chriſt 1745 of equal Time,

The Apogæum of the Sun was 3 Signs $+08^{\circ}+20'+26''+30'''+56''''$.

The Sun's Place according to the middle Motion was 9 Sig. $+21^{\circ}+05'+33''+21'''+54''''$.

The Place of the Sun's apparent Motion was 9 Sig. $+21^{\circ}+31'+22''+19'''+09''''$, each Eaſtward from ♈.

4. So from the Beginning of the Sign ♎, ſubſtracting the Sun's apparent Place $=21^{\circ}+31'+22''+19'''+09''''$ of ♑, we have the Remainder $=8$ Sig. $+08^{\circ}+28'+37''+40'''+51''''$ $=$Arch of the Ecliptick under which the Sun by its apparent Motion paſſes betwixt the 31ſt aſtronomical Day of *December* (O. S.), at 5 Hours $+4$ min. 45 ſec. of equal Time, in the *Julian* Year of Chriſt 1745, and the Moment at which the Sun was come to the Beginning of the Sign ♎, in the *Julian* Year of Chriſt 1746 of equal Time at *Greenwich*.

5. Then I find, by my Tables, that whilſt the Sun was paſſing by its middle Motion under the Arch of the Ecliptick $=8$ Sig. $+08^{\circ}+28'+37''+40'''+51''''$ there were taken up 252 Days + 2 Hours + 17 min. + 23 ſec. + 51 thirds 45 fourths of equal Time nearly; and that during this Space of equal Time the Apogæum of the Sun's Orbit moved Eaſtward $=34''+29'''+46''''$ nearly.

So, for the like Reaſon given above in 1ſt Example, Num. 5. adding this Motion of the Apogæum to the Place of the Sun's Apogæum at the End of the 5 *Julian* Years 5 Hours 4 min. 45 ſec. of equal Time, we have the Sum $=3$ Sig. $+8^{\circ}+21'+01''+00'''+42''''$ Eaſtward from ♈ for the Place of the Apogæum of the Sun, nearly, at the Moment of equal Time at which the Sun was come by its apparent Motion to the Beginning of the Sign ♎ in the ſaid Year 1746, *viz.* for the Angle ♈TA in the 1ſt Fig. for Ch. IV. Sect. 1. Num. 4.

Angle ♈TA.

So ſubſtracting this Angle ♈TA from the Sun's apparent Diſtance from ♈ when it was come to the Beginning of the Sign ♎, we have the Remainder $=2$ Sig. $+21^{\circ}+38'+58''+59'''+18''''$ for the Sun's true Anomaly at that Moment [as in 1ſt Note ſubjoined to Num. 8. in Chap. IV. Sect. 1.].

True Anomaly.

So the true Anomaly being $<$ 6 Signs, we have the mean Anomaly at that Moment $=$ the true Anomaly $+$ the Equation of the Orbit correſponding thereto [by the Reverſe of Chap. IV. Sect. 1. Num. 5.]

And for finding the mean Anomaly correſponding hereto, by examining my Table of the Equations of the Sun's elliptical Orbit, I find that the mean Anomaly required was $>$ 2 Signs $+23^{\circ}$ and $<$ 2 Signs $+24^{\circ}$. For,

Putting the mean Anomaly $=2$ Sig. $+23^{\circ}+00'+00''+00'''+00''''$, we have the Equation of the Orbit correſponding $=0$ Sig. $+01^{\circ}+52'+36''+51'''+05''''$.

Subſtract this from mean Anomaly, we have the Remainder for the true Anomaly correſponding to 2 Sig. $+23^{\circ}=2$ Sig. $+21^{\circ}+07'+23''+08'''+55''''$.

This is $<$ the true Anomaly given by $31' + 35'' + 50''' + 23''''$, *viz.* by $6825023''''$. And

Putting the mean Anomaly $= 2$ Signs $+ 24° + 00' + 00'' + 00''' + 00''''$, we have the Equation of the Orbit correſponding $= 0$ Sig. $+ 01° + 52' + 52'' + 23''' + 24''''$.

Subſtract this from mean Anomaly, we have the Remainder for the true Anomaly correſponding to 2 Sig. $+ 24° = 2$ Sig. $+ 22° + 07 + 07 + 36 + 36$.

This is $>$ true Anomaly given by $28' + 08'' + 37''' + 18''''$, *viz.* by $6079038''''$.

6. Now in putting the mean Anomaly $= 2$ Sig. $+ 24°$, we have the true Anomaly bigger than it ſhould be by $6079038''''$, which I call b.

And in putting the mean Anomaly $= 2$ Signs $+ 23°$, we have the true Anomaly leſs than it ſhould be by $6825023''''$, which I call a.

And 2 Sig. $+ 24° -$ 2 Sig. $+ 23° = 12960000''''$. This I call D.

Let D be divided into two Parts, ſo as that a proportional Part of it ſhall correſpond to b, which Part I call x. So the remaining Part correſponding to $a = D - x$. Then ſay, As $b : a :: $ So $x : D - x$. So $ax = bD - bx$. So $ax + bx = bD$. So $x = \frac{bD}{a+b}$.

Where $bD = 78784332480000$. And $a + b = 12904061$ fourths.

So $\frac{bD}{a+b} = 6105390'''',58 + = 28$ minutes 15 ſec. 56 th. $30'''',58 + = x$.

x
D—x

And $D - x = 31$ min. 44 ſec. 03 th. $29'''',42 -$

So from the bigger mean Anomaly $= 2$ Sig. $24°$ 00 min. 00 ſec. 00 th. 00 fourths, Subſtracting $x = 0$ Sig. 00° 28 min. 15 ſec. 56 th. 30,58+,

We have the Remainder 2 Sig. 23°+31+44+03+29,42 — for the mean Anomaly correſponding to the true Anomaly given in Num. 5. above.

And we have the Equation of the Orbit correſponding to this mean Anomaly = 1° 52 min. 45 ſec. 04 th. 11,42—

For Equation to 2 Sig.+24—Equat. to 2 Sig. +23° = 55939 fo. = D.

And the prime Scruples, *&c.* annexed in the mean Anomaly = 6854609,42—

And as 1° (12960000 fo.) : D (55939 fo.) :: So the Scruples annexed (6854609‴′,42—) : 29586,42— = 8 ſec. 13 th. 06,42—To this

Adding the Equation to 2 Sig. + 23° = 1° 52 min. 36 ſec. 51 th. 05 fou.

Equation of the Orbit.

We have the Sum = 1° 52 min. 45 ſec. 04 th. 11,42 — = Equation of the Orbit correſponding to the mean Anomaly above.

So from the bigger mean Anomaly = 2 Sig. 24° 00 min. 00 ſec. 00 th. 00 fou.

Subſtracting $x = 0$ Sig. 00° 28 min. 15 ſec. 56 th. 30 fourths,58+

Mean Anomaly.

We have the Remainder = 2 Sig. 23° 31 min. 44 ſec. 03 th. 29 fourths,42— for the mean Anomaly correſponding to the true Anomaly found above [in Num. 5.].

For from this mean Anomaly = 2 Sig. 23° 31 min. 44 ſec. 03 th. 29 fourths,42

Subſtracting Equation of Orbit = 0 Sig. 01° 52 min. 45 ſec. 04 th: 11 fourths,42,

We have the Remainder = 2 Sig. 21° 38 mi. 58 ſec. 59 th. 18 fou. = the true Anomaly found above [in Num. 5.].

Then to this mean Anomaly = 2 Sig. 23° 31 min. 44 ſec. 03 th. 29 fourths,42

Adding the Diſtance of the Apogæum Eaſtw. from ♈ at the End of the Interval of equal Time forward = 3 Sig. 08° 21 min. 01 ſec. 00 th. 42 fourths [Num. 5.] ;

We have the Sum = 6 Sig. 01° 52 min. 45 ſec. 04 th. 11 fourths,42 Eaſtward from the Beginning of the Sign ♈ for the Place of the Sun's middle Motion under the Eclipticк at the Moment of equal Time at which the Sun was come to the 1ſt Point of the Sign ♎ according to its apparent Motion.

Out of this ſubſtracting the Sun's middle Motion under the Ecliptick at the End of the 5 tropical Years forward from the radical Moment =9 Sig. 21° 05 min. 33 ſec. 21 th. 54 fourths [Num. 1.], we have the Remainder 8 Sig. 10° 47 min. 11 ſec. 42 th. 17 fourths,42= Sun's middle Motion under the Ecliptick in the Interval of equal Time, betwixt the End of the 5 tropical Years, and the Moment at which the Sun was come to the 1ſt Point of the Sign ♎, according to apparent Motion.

7. Here 8 Sig. 10° 47 min. 11 ſec. 42 th. 17 fourths,42=3250294137 fourths,42.

And in 365 Days of equal Time Sun's middle Motion under Ecliptick =4662504526 fourths, 3423380 [1ſt Exam. Num. 7.]

Then ſay, As 4662504526$''''$,34 : 365 Days (113529600000 fourths) : : So 3250294137$''''$, 42 : 79142999480 fourths=254 Days 10 hours 42 min. 46 ſec. 31 th. 20 fourths of equal Time. Then,

Adding 000 Days 05 hours 04 min. 45 ſec. viz. the equal Time taken up betwixt Noon on the 31ſt aſtronomical Day of *December*, at the End of the *Julian* Year of Chriſt 1745, and the End of the 5 tropical Years above-mentioned;

We have the Sum = 254 Days 15 hours 47 min. 31 ſec. 31 th. 20 fou. of equal Time, being the Quantity of Time taken up betwixt Noon on the Beginning of the 31ſt aſtronomical Day of *December* at the End of the *Julian* Year of Chriſt 1745, and the Moment at which the Sun was come next to be diſtant Eaſtward from ♈ = 6 Sig. 01° 52 min. 45 ſec. 04 th. 11'''',42 according to the middle Motion [as in Num. 6.].

And the End of this equal Time forw. from the ſaid Noon on the ſaid 31ſt Day of *December* in the ſaid Year 1745 was on the 11th aſtronomical Day of *September* at 15 Hours 47 min. 31 ſec. 31 th. 20 fourths of equal Time in the *Julian* Year of Chriſt 1746.

Then becauſe the true Anomaly is < 6 Signs [as in Num. 5. above];

From the Place of the Sun's middle Motion found above, in Num. 6. at the end of the Interval of equal Time forward, = 6 Signs 01° 52 min. 45 ſec. 04 th. 11'''',42 Eaſtw. from ♈,

Subſtract the Equation of Orbit in Num. 6. = 0 Sign 01° 52 min. 45 ſec. 04 th. 11'''',42; we have

The Remainder = 6 Sign. 00° 00 min. 00 ſec. 00 th. 00 fou. Eaſtw. from ♈ for the Place of the Sun's apparent Motion on the ſaid 11th Day of *September* at 15 Hours 47 min. 31 ſec. 31 th. 20 fourths of equal Time [Chap. IV. Sect. 1. Num. 5.]

And the Sun's right Aſcenſion correſponding to this apparent Place of the Sun = 6 Sig. 00° 00 min. 00 ſec. 00 th. 00 fou.

So, becauſe the Sun's right Aſcenſion at the radical Moment $>$ the Sun's right Aſcenſion at the End of Interval of equal Time forward; therefore

Subſtracting the Sun's right Aſcenſion at the radical Moment from 12 Signs, we have the Remainder = 2 Sig. 06° 43 min. 52 ſec. 06 th. 44 fourths; to which

Adding the right Aſcenſion at the End of Interval of equal Time forward = 6 Sig. 00° 00 min. 00 ſec. 00 th. 00 fou. we have

The Sum for the aſcenſional Difference 8 Sig. 06° 43 min. 52 ſec. 06 th. 44 fou. [Chap. V. Sect. 1. Num. 13. 2d Inſtance, 1ſt Caſe].

8. Then working as in Sect. 1. 1ſt Example 1ſt Operation, I find the Sun's middle Motions under the Ecliptick in the 5 *Julian* Years 254 days 15 hours 47 min. 31 ſec. 31 th. 20 fou. of equal Time to be = 8 Sig. 10° 47 min. 39 ſec. 28 th. 55 fo. above the intire Revolutions.

ξ ♏ $+\frac{\xi}{z}$

This is ξ ♏ $+\frac{\xi}{z}$ [Chap. V. Sect. 1. Num. 14].

Here the aſcenſional Difference $<$ ξ ♏ $+\frac{\xi}{z}$ by $4^{\circ}+03'+47''+22'''+11''''$. And the equal Time taken up whilſt this Arch of the Equinoctial was rolling Weſtward by the diurnal Motion under the Semimeridian of G, was = 16 mi. 24 ſec. 29 th. 44 fou. of equal Time [by my Table of equal Time, *&c.*].

Equation of Time.

This is the Equation of Time, which, becauſe the aſcenſional Difference $<$ ξ ♏ $+\frac{\xi}{z}$, muſt be ſubſtracted from the 11th aſtronomical Day of *September* aforeſaid at 15 Hours 47 min. 39 ſec. 28 th. 55 fou. of equal Time, to give a Remainder

Sun's apparent Ingreſs into the Sign ♎ in 1746.

der = 11th aſtronomical Day of *September* (O.S.) at 15 hours 31 min. 14 ſec. 59 th. 11 fourths of apparent Time at *Greenwich* in the *Julian* Year of Chriſt 1746; at which Moment of apparent Time the Sun was come to the Beginning of the Sign ♎ according to its apparent Motion [Sect. 1. 1ſt Exam. Num. 7. 2d Caſe].

By the like Method may the Moment of apparent Time be determined of the Sun's apparent Ingreſs into any of the Signs or Points of the Ecliptick in its Deſcent from the Apogæum to the Perigæum in any Year.

ASTRO-

Aſtronomical

TABLES.

FIRST TABLE.

A TABLE of the Diſtances of the Sun's Apogæum, and of the Diſtances of the Sun's Centre, both according to the middle and the apparent Motions, Eaſtward from the Vernal Equinox; together with a Table of the Sun's right Aſcenſions correſponding to the ſeveral Degrees of the Ecliptick, at the Beginnings of the ſeveral radical Julian Years of Chriſt of apparent Time, reſpectively expreſſed in the Column on the left Hand, according to the Old Style, at Greenwich.

Note. Each radical Julian Year of Chriſt begins at Noon at the Beginning of the 31ſt aſtronomical Day of *December*, at the End of each foregoing Julian Year of Chriſt; which Moment with me is the Radix of the Julian Year of Chriſt next following.

	Diſtance of the Sun's Apogæum, Eaſtward from the Vernal Equinox.	*Sun's middle Motion Eaſtward from the Vernal Equinox.*	*Sun's apparent Motion Eaſtward fr. the Vernal Equinox.*	*Sun's right Aſcenſion at the radical Moment.*
	Si. ° ′ ″ ‴ ⁗	Si. ° ′ ″ ‴ ⁗	Si. ° ′ ″ ‴ ⁗	Si. ° ′ ″ ‴ ⁗
1	2 14 06 52 00 41	9 07 55 49 00 00	9 08 42 59 49 01	9 09 29 23 16 14
1601	3 06 19 39 28 10	9 20 02 00 19 45	9 20 29 42 49 13	9 22 10 21 07 11
1681	3 07 26 17 50 33	9 20 38 19 00 10	9 21 05 01 24 20	9 22 43 02 46 26
1701	3 07 42 57 26 09	9 20 47 23 37 26	9 21 13 51 00 10	9 22 57 21 10 18
1721	3 07 59 37 01 44	9 20 56 28 14 39	9 21 22 40 34 10	9 23 06 44 16 38
1741	3 08 16 16 37 20	9 21 05 33 21 54	9 21 31 30 36 39	9 23 16 07 53 16

SECOND TABLE

A TABLE of the Motion of the Sun Eaſtward in its Orbit according to the middle Motion over and above the intire Revolutions: And alſo, A Table of the Motion of the Sun's Apogæum Eaſtward under the Ecliptick correſponding to the Spaces of the ſeveral Julian Years deſcribed in the Column on the Left Hand.

Juli. years	The Sun's middle Motion in its Orbit.						The Motion of the Sun's Apogæum.						Sun's Revolutions round its Orbit by the middle Motion in the Jul. years on the left Hand.
	Sign	°	′	″	‴	⁗	Si.	°	′	″	‴	⁗	
1	11	29	44	50	12	02	0	0	0	49	56	44	0
2	11	29	29	40	24	05	0	0	1	39	53	27	1
3	11	29	14	30	36	08	0	0	2	29	50	11	2
4	11	29	58	28	59	43	0	0	3	19	55	7	3
5	11	29	43	19	11	46	0	0	4	9	51	51	4
6	11	29	28	9	23	48	0	0	4	59	48	34	5
7	11	29	12	59	35	51	0	0	5	49	45	18	6
8	11	29	56	57	59	26	0	0	6	39	50	14	7
9	11	29	41	48	11	29	0	0	7	29	46	58	8
10	11	29	26	38	23	33	0	0	8	19	43	41	9
11	11	29	11	28	35	36	0	0	9	9	40	25	10
12	11	29	55	26	59	10	0	0	9	59	45	21	11
13	11	29	40	17	11	13	0	0	10	49	42	5	12
14	11	29	25	7	23	16	0	0	11	39	38	48	13
15	11	29	9	57	35	18	0	0	12	29	35	32	14
16	11	29	53	55	58	53	0	0	13	19	40	28	15
17	11	29	38	46	10	56	0	0	14	9	37	12	16
18	11	29	23	36	22	59	0	0	14	59	33	56	17
19	11	29	8	26	35	2	0	0	15	49	30	40	18
20	11	29	52	24	58	38	0	0	16	39	35	36	19
40	11	29	44	49	57	16	0	0	33	19	11	11	39
60	11	29	37	14	55	54	0	0	49	58	46	47	59
80	11	29	29	39	54	32	0	1	6	38	22	23	79
100	11	29	22	4	53	9	0	1	23	17	57	58	99
200	11	28	44	9	46	18	0	2	46	35	55	56	199
300	11	28	6	14	39	28	0	4	9	53	53	54	299
400	11	27	28	19	32	37	0	5	33	11	51	52	399
500	11	26	50	24	25	46	0	6	56	29	49	50	499
600	11	26	12	29	18	55	0	8	19	47	47	48	599
700	11	25	34	34	12	4	0	9	43	5	45	46	699
800	11	24	56	29	5	13	0	11	6	23	43	44	799
900	11	24	18	43	58	22	0	12	29	41	41	42	899
000	11	23	40	48	51	33	0	13	52	59	39	40	999
2000	11	17	21	37	43	7	0	27	45	59	19	20	1999
3000	11	11	2	26	34	40	1	11	38	58	59	00	2999
4000	11	04	43	15	26	14	1	25	31	58	38	40	3999

THIRD

THIRD TABLE.

A TABLE of the middle Motion of the Sun Eaſtward; and, A Table of the Motion of the Apogæum Eaſtward, under the Ecliptick, from Noon at the Beginning of the 31ſt aſtronomical Day of December, to Noon at the Beginning of each aſtronomical Day of each Month of the Year.

The Month is named on the Top; and the Beginning of each Day of the Month is ſet down in the Column on the left Hand.

Days of Mo.	January.									February.								
	Middle Motion of the Sun.						Mot. of Apog.			Middle Motion of the Sun.						Mot. of Apog.		
	Si.	°	′	″	‴	⁗	″	‴	⁗	Si.	°	′	″	‴	⁗	″	‴	⁗
1	0	0	59	8	11	32	0	8	13	1	1	32	22	9	16	4	22	43
2	0	1	58	16	23	05	0	16	25	1	2	31	30	20	49	4	30	56
3	0	2	57	24	34	37	0	24	38	1	3	30	38	32	21	4	39	8
4	0	3	56	32	46	09	0	32	50	1	4	29	46	43	53	4	47	21
5	0	4	55	40	57	43	0	41	3	1	5	28	54	55	26	4	55	34
6	0	5	54	49	9	15	0	49	16	1	6	28	3	6	58	5	3	46
7	0	6	53	57	20	47	0	57	28	1	7	27	11	18	31	5	11	59
8	0	7	53	5	32	19	1	5	41	1	8	26	19	30	3	5	20	12
9	0	8	52	13	43	51	1	13	54	1	9	25	27	14	35	5	28	25
10	0	9	51	21	55	24	1	22	6	1	10	24	35	53	7	5	36	38
11	0	10	50	30	6	56	1	30	19	1	11	23	44	4	40	5	44	50
12	0	11	49	38	18	28	1	38	32	1	12	22	52	16	13	5	53	3
13	0	12	48	46	30	1	1	46	44	1	13	22	0	27	44	6	1	15
14	0	13	47	54	41	33	1	54	57	1	14	21	8	39	17	6	9	28
15	0	14	47	2	53	5	2	3	9	1	15	20	16	50	49	6	17	41
16	0	15	46	11	4	38	2	11	22	1	16	19	25	2	22	6	25	53
17	0	16	45	19	16	10	2	19	35	1	17	18	33	13	55	6	34	6
18	0	17	44	27	27	43	2	27	47	1	18	17	41	25	27	6	42	19
19	0	18	43	35	39	15	2	36	0	1	19	16	49	36	59	6	50	31
20	0	19	42	43	50	48	2	44	12	1	20	15	57	48	31	6	58	44
21	0	20	41	52	2	20	2	52	25	1	21	15	6	0	4	7	6	56
22	0	21	41	0	13	52	3	0	38	1	22	14	14	11	36	7	15	9
23	0	22	40	8	25	25	3	8	50	1	23	13	22	23	8	7	23	21
24	0	23	39	16	36	57	3	17	3	1	24	12	30	34	41	7	31	34
25	0	24	38	24	48	29	3	25	15	1	25	11	38	46	13	7	39	47
26	0	25	37	33	0	2	3	33	28	1	26	10	46	57	46	7	47	59
27	0	26	36	41	11	34	3	41	41	1	27	9	55	9	18	7	56	12
28	0	27	35	49	23	7	3	49	53	1	28	9	3	20	50	8	4	25
29	0	28	34	57	34	39	3	58	6									
30	0	29	34	5	46	12	4	6	18									
31	1	0	33	13	57	44	4	14	31									

From the Beginning of the radical Year to the Beginning of the

10th of January	10 days	9th of February	40 days	11th of March	70 days
20th ——	20 ——	19th ——	50 ——	21ſt ——	80 ——
30th ——	30 ——	1ſt of March	60 ——	31ſt ——	90 ——

IIId TABLE.

A TABLE of the middle Motion of the Sun Eaſtward; and A Table of the Motion of the Apogæum Eaſtward, &c.

Days of Mo.	March.									April.								
	Middle Motion of the Sun.						Motion of Apog.			Middle Motion of the Sun.						Motion of Apog.		
	Si.	°	′	″	‴	⁗	″	‴	⁗	Si.	°	′	″	‴	⁗	″	‴	⁗
1	1	29	8	11	32	23	8	12	37	2	29	41	25	30	7	12	27	8
2	2	0	7	19	43	55	8	20	50	3	0	40	33	41	40	12	35	20
3	2	1	6	27	55	28	8	29	2	3	1	39	41	53	12	12	43	33
4	2	2	5	36	7	0	8	37	15	3	2	38	50	4	44	12	51	45
5	2	3	4	44	18	32	8	45	27	3	3	37	58	16	17	12	59	58
6	2	4	3	52	30	5	8	53	40	3	4	37	6	27	49	13	8	11
7	2	5	3	0	41	37	9	1	53	3	5	36	14	39	22	13	16	23
8	2	6	2	8	53	10	9	10	5	3	6	35	22	50	54	13	24	36
9	2	7	1	17	4	42	9	18	18	3	7	34	31	2	26	13	32	49
10	2	8	0	25	16	14	9	26	31	3	8	33	39	13	59	13	41	1
11	2	8	59	33	27	47	9	34	43	3	9	32	47	25	31	13	49	14
12	2	9	58	41	39	19	9	42	56	3	10	31	55	37	4	13	57	26
13	2	10	57	49	50	51	9	51	9	3	11	31	3	48	36	14	5	39
14	2	11	56	58	2	24	9	59	21	3	12	30	12	0	8	14	13	51
15	2	12	56	6	13	56	10	7	33	3	13	29	20	11	41	14	22	4
16	2	13	55	14	25	29	10	15	46	3	14	28	28	23	13	14	30	17
17	2	14	54	22	37	1	10	23	59	3	15	27	36	34	46	14	38	29
18	2	15	53	30	48	34	10	32	11	3	16	26	44	46	18	14	46	42
19	2	16	52	39	0	6	10	40	24	3	17	25	52	57	50	14	54	55
20	2	17	51	47	11	38	10	48	37	3	18	25	1	9	23	15	3	7
21	2	18	50	55	23	11	10	56	49	3	19	24	9	20	55	15	11	20
22	2	19	50	3	34	43	11	5	2	3	20	23	17	32	28	15	19	32
23	2	20	49	11	46	16	11	13	14	3	21	22	25	44	0	15	27	45
24	2	21	48	19	57	48	11	21	27	3	22	21	33	55	32	15	35	57
25	2	22	47	28	9	20	11	29	39	3	23	20	42	7	[illegible]	15	44	10
26	2	23	46	36	20	53	11	37	52	3	24	19	50	16	37	15	52	23
27	2	24	45	44	32	25	11	46	5	3	25	18	58	30	10	16		36
28	2	25	44	52	43	58	11	54	17	3	26	18	6	41	42	16	8	48
29	2	26	44	0	55	30	12	2	30	3	27	17	14	53	14	16	17	1
30	2	27	43	9	7	2	12	10	43	3	28	16	23	4	47	16	25	13
31	2	28	42	17	18	35	12	18	55									

From the Beginning of the radical Year to the Beginning of the

10th of April	100 days	10th of May	130 days	9th of June	160 days
20th ——	110——	20th ——	140——	19th ——	170——
30th ——	120——	30th ——	150——	29th ——	180——

III^d TABLE.

A TABLE of the middle Motion of the Sun Eaſtward; and A Table of the Motion of the Apogæum Eaſtward, &c.

	May.									June.								
ays of Mo.	Middle Motion of the Sun.						Motion of Apog.			Middle Motion of the Sun.						Motion of Apog.		
	Si.	°	′	″	‴	⁗	″	‴	⁗	Si.	°	′	″	‴	⁗	″	‴	⁗
1	3	29	15	31	16	19	16	33	26	4	29	48	45	14	3	20	47	57
2	4	0	14	39	27	52	16	41	38	5	0	47	53	25	35	20	56	10
3	4	1	13	47	39	24	16	49	51	5	1	47	1	37	7	21	4	22
4	4	2	12	55	50	56	16	58	3	5	2	46	9	48	40	21	12	35
5	4	3	12	4	2	29	17	6	16	5	3	45	18	0	12	21	20	48
6	4	4	11	12	14	1	17	14	29	5	4	44	26	11	45	21	29	0
7	4	5	10	20	25	34	17	22	41	5	5	43	34	23	17	21	37	13
8	4	6	9	28	37	6	17	30	54	5	6	42	42	34	49	21	45	26
9	4	7	8	36	48	38	17	39	7	5	7	41	50	46	22	21	53	38
10	4	8	7	45	0	11	17	47	19	5	8	40	58	57	54	22	1	51
11	4	9	6	53	11	43	17	55	32	5	9	40	7	9	27	22	10	3
12	4	10	6	1	23	16	18	3	44	5	10	39	15	20	59	22	18	16
13	4	11	5	9	34	48	18	11	57	5	11	38	23	32	31	22	26	28
14	4	12	4	17	46	20	18	20	9	5	12	37	31	44	4	22	34	41
15	4	13	3	25	57	53	18	28	22	5	13	36	39	55	36	22	42	54
16	4	14	2	34	9	25	18	36	35	5	14	35	48	7	9	22	51	6
17	4	15	1	42	20	58	13	44	47	5	15	34	56	18	41	22	59	19
18	4	16	0	50	32	30	18	53	0	5	16	34	4	30	13	23	7	32
19	4	16	59	58	44	2	19	1	13	5	17	33	12	41	46	23	15	44
20	4	17	59	6	55	34	19	9	26	5	18	32	20	53	18	23	23	57
21	4	18	58	15	7	6	19	17	36	5	19	31	29	4	51	23	32	9
22	4	19	57	23	18	39	19	25	51	5	20	30	37	16	23	23	40	22
23	4	20	56	31	30	11	19	34	4	5	21	29	45	27	55	23	48	34
24	4	21	55	39	41	43	19	42	16	5	22	28	53	39	28	23	56	47
25	4	22	54	47	53	16	19	50	29	5	23	28	1	51	0	24	5	0
26	4	23	53	56	4	48	19	58	42	5	24	27	10	2	33	24	13	12
27	4	24	53	4	16	21	20	6	54	5	25	26	18	14	5	24	21	25
28	4	25	52	12	27	53	20	15	7	5	26	25	26	25	37	24	29	38
29	4	26	51	20	39	25	20	23	20	5	27	24	34	37	10	24	37	50
30	4	27	50	28	50	58	20	31	32	5	28	23	42	48	42	24	46	3
31	4	28	49	37	2	30	20	39	45									

From the Beginning of the radical Year to the Beginning of the

9th of July	190 days	8th of Auguſt	220 days	7th of September	250 days
19th	200	18th	230	17th	260
29th	210	28th	240	27th	170

III^d

III^{d} TABLE.

A TABLE of the middle Motion of the Sun Eaſtward; and A Table of the Motion of the Apogæum Eaſtward, &c.

	July.									August.								
Days of Mo.	Middle Motion of the Sun.						Motion of Apog.			Middle Motion of the Sun.						Motion of Apog.		
	Si.	°	′	″	‴	⁗	″	‴	⁗	Si.	°	′	″	‴	⁗	″	‴	⁗
1	5	29	22	51	20	15	24	54	15	6	29	56	4	57	59	29	8	47
2	6	0	21	59	11	47	25	2	28	7	0	55	13	9	31	29	16	59
3	6	1	21	7	23	19	25	10	40	7	1	54	21	21	4	29	25	12
4	6	2	20	15	34	52	25	18	53	7	2	53	29	32	36	29	33	25
5	6	3	19	23	46	24	25	27	6	7	3	52	37	44	0	29	41	37
6	6	4	18	31	57	57	25	35	18	7	4	51	45	55	41	29	49	50
7	6	5	17	40	9	29	25	43	31	7	5	50	54	7	13	29	58	3
8	6	6	16	48	21	1	25	51	44	7	6	50	2	18	46	30	6	15
9	6	7	15	56	32	34	25	59	56	7	7	49	10	30	18	30	14	28
10	6	8	15	4	44	6	26	8	9	7	8	48	18	41	51	30	22	40
11	6	9	14	12	55	39	26	16	21	7	9	47	26	53	23	30	30	53
12	6	10	13	21	7	11	26	24	34	7	10	46	35	4	55	30	39	5
13	6	11	12	29	18	43	26	32	46	7	11	45	43	16	28	30	47	18
14	6	12	11	37	30	16	26	40	59	7	12	44	51	28	0	30	55	31
15	6	13	10	45	41	48	26	49	12	7	13	43	59	39	33	31	3	43
16	6	14	9	53	53	21	26	57	24	7	14	43	7	51	5	31	11	56
17	6	15	9	2	4	53	27	5	37	7	15	42	16	2	37	31	20	9
18	6	16	8	10	16	25	27	13	50	7	16	41	24	14	10	31	28	21
19	6	17	7	18	27	58	27	22	3	7	17	40	32	25	42	31	36	34
20	6	18	6	26	39	30	27	30	16	7	18	39	40	37	15	31	44	46
21	6	19	5	34	51	3	27	38	28	7	19	38	48	48	47	31	52	59
22	6	20	4	43	2	35	27	46	41	7	20	37	57	0	19	32	1	11
23	6	21	3	51	14	7	27	54	53	7	21	37	5	11	52	32	9	24
24	6	22	2	59	25	40	28	3	6	7	22	36	13	23	24	32	17	37
25	6	23	2	7	37	12	28	11	19	7	23	35	21	34	57	32	25	49
26	6	24	1	15	48	45	28	19	31	7	24	34	29	46	29	32	34	2
27	6	25	0	24	0	16	28	27	44	7	25	33	37	58	1	32	42	15
28	6	25	59	32	11	49	28	35	57	7	26	32	46	9	33	32	50	28
29	6	26	58	40	23	22	28	44	9	7	27	31	54	21	5	32	58	41
30	6	27	57	48	34	54	28	52	22	7	28	31	2	32	38	33	6	53
31	6	28	56	56	46	27	29	0	34	7	29	30	10	44	10	33	15	6

From the Beginning of the radical Year to the Beginning of the

7th of October	280 days	6th of Novemb.	310 days	6th of Decemb.	340 days
17th ——	290——	16th ——	320——	16th ——	350——
27th ——	300——	26th ——	330——	26th ——	360——

III^{d}

III^d TABLE.

A TABLE of the middle Motion of the Sun Eaſtward; and A Table of the Motion of the Apogæum Eaſtward, &c.

Days of M.	September.									October.								
	Middle Motion of the Sun.						Motion of Apog.			Middle Motion of the Sun.						Motion of Apog.		
	Si.	°	′	″	‴	⁗	″	‴	⁗	Si.	°	′	″	‴	⁗	″	‴	⁗
1	8	0	29	18	55	43	33	23	18	9	0	3	24	41	54	37	29	36
2	8	1	28	27	7	15	33	31	30	9	1	2	32	53	27	37	37	49
3	8	2	27	35	18	47	33	39	43	9	2	1	41	4	59	37	46	2
4	8	3	26	43	30	19	33	47	56	9	3	0	49	16	32	37	54	14
5	8	4	25	51	41	52	33	56	8	9	3	59	57	28	4	38	2	27
6	8	5	24	59	53	25	34	4	21	9	4	59	5	39	36	38	10	40
7	8	6	24	8	4	57	34	12	33	9	5	58	13	51	9	38	18	52
8	8	7	23	16	16	29	34	20	46	9	6	57	22	2	41	38	27	5
9	8	8	22	24	28	1	34	28	59	9	7	56	30	14	14	38	35	17
10	8	9	21	32	39	33	34	37	11	9	8	55	38	25	46	38	43	30
11	8	10	20	40	51	6	34	45	24	9	9	54	46	37	18	38	51	42
12	8	11	19	49	2	39	34	53	36	9	10	53	54	48	51	38	59	55
13	8	12	18	57	14	11	35	1	49	9	11	53	3	0	23	39	8	8
14	8	13	18	5	25	42	35	10	2	9	12	52	11	11	56	39	16	20
15	8	14	17	13	37	15	35	18	14	9	13	51	19	23	28	39	24	33
16	8	15	16	21	48	48	35	26	26	9	14	50	27	35	0	39	32	46
17	8	16	15	30	0	21	35	34	39	9	15	49	35	46	33	39	40	58
18	8	17	14	38	11	53	35	42	53	9	16	48	43	58	5	39	49	11
19	8	18	13	46	23	26	35	51	5	9	17	47	52	9	38	39	57	23
20	8	19	12	54	34	58	35	59	18	9	18	47	0	21	10	40	5	36
21	8	20	12	2	46	30	36	7	30	9	19	46	8	32	42	40	13	48
22	8	21	11	10	58	3	36	15	43	9	20	45	16	44	15	40	22	1
23	8	22	10	19	9	35	36	23	56	9	21	44	24	55	47	40	30	14
24	8	23	9	27	21	8	36	32	8	9	22	43	33	7	20	40	38	26
25	8	24	8	35	32	40	36	40	21	9	23	42	41	18	52	40	46	39
26	8	25	7	43	44	12	36	48	34	9	24	41	49	30	24	40	54	52
27	8	26	6	51	55	45	36	56	46	9	25	40	57	41	57	41	3	4
28	8	27	6	0	7	17	37	4	59	9	26	40	5	53	29	41	11	17
29	8	28	5	8	18	50	37	13	11	9	27	39	14	5	2	41	19	29
30	8	29	4	16	30	22	37	21	24	9	28	38	22	16	34	41	27	42
31										9	29	37	30	28	6	41	35	54

III^d TABLE.

A TABLE of the middle Motion of the Sun Eaſtward; *and A Table of the Motion of the Apogæum Eaſtward*, &c.

Days of Mo.	November.									December.								
	Middle Motion of the Sun.						Motion of Apog.			Middle Motion of the Sun.						Motion of Apog.		
	Si.	°	′	″	‴	⁗	″	‴	⁗	Si.	°	′	″	‴	⁗	′	‴	⁗
1	10	0	36	38	39	39	41	44	7	11	0	10	44	25	51	45	50	25
2	10	1	35	46	51	11	41	52	20	11	1	9	52	37	23	45	58	38
3	10	2	34	55	2	44	42	0	32	11	2	9	0	48	56	46	6	50
4	10	3	34	3	14	16	42	8	45	11	3	8	9	0	28	46	15	3
5	10	4	33	11	25	48	42	16	58	11	4	7	17	12	0	46	23	16
6	10	5	32	19	37	21	42	25	10	11	5	6	25	23	34	46	31	29
7	10	6	31	27	48	53	42	33	23	11	6	5	33	35	6	46	39	42
8	10	7	30	36	0	26	42	41	35	11	7	4	41	46	39	46	47	54
9	10	8	29	44	11	58	42	49	48	11	8	3	49	58	11	46	56	7
10	10	9	28	52	23	30	42	58	0	11	9	2	58	9	43	47	4	19
11	10	10	28	0	35	3	43	6	13	11	10	2	6	21	15	47	12	32
12	10	11	27	8	46	35	43	14	26	11	11	1	14	32	48	47	20	45
13	10	12	26	16	58	8	43	22	38	11	12	0	22	44	21	47	28	57
14	10	13	25	25	9	40	43	30	51	11	12	59	30	55	53	47	37	10
15	10	14	24	33	21	12	43	39	4	11	13	58	39	7	25	47	45	23
16	10	15	23	41	32	45	43	47	16	11	14	57	47	18	56	47	53	35
17	10	16	22	49	44	17	43	55	29	11	15	56	55	30	28	48	1	48
18	10	17	21	57	55	50	44	3	41	11	16	56	3	42	1	48	10	0
19	10	18	21	6	7	22	44	11	54	11	17	55	11	53	33	48	18	13
20	10	19	20	14	18	54	44	20	6	11	18	54	20	5	5	48	26	25
21	10	20	19	22	30	27	44	28	19	11	19	53	28	16	38	48	34	38
22	10	21	18	30	41	59	44	36	32	11	20	52	36	28	10	48	42	51
23	10	22	17	38	53	32	44	44	44	11	21	51	44	39	43	48	51	3
24	10	23	16	47	5	4	44	52	57	11	22	50	52	51	15	48	59	16
25	10	24	15	55	16	36	45	1	10	11	23	50	1	2	47	49	7	29
26	10	25	15	3	28	9	45	9	22	11	24	49	9	14	20	49	15	41
27	10	26	14	11	39	41	45	17	35	11	25	48	17	25	52	49	23	54
28	10	27	13	19	51	14	45	25	47	11	26	47	25	37	25	49	32	6
29	10	28	12	28	2	46	45	34	0	11	27	46	33	48	57	49	40	19
30	10	29	11	36	14	18	45	42	12	11	28	45	42	0	29	49	48	31
31										11	29	44	50	12	2	49	56	44

NB. If the Year in which the Day is whereon the Sun's Places are required be Biſſextile (or Leap-Year), and if the Day be after *February*, you muſt add a Day to your Number of Days.

FOURTH TABLE.

A TABLE of the middle Motion of the Sun in its Orbit:

AND

A Table of the Motion of the Apogæum for Hours, Minutes, Seconds, Thirds, and Fourths.

Hours Min. Sec. Thirds fourths	Middle Motion of the Sun in its Orbit.					Motion of Apogæum		Hours Min. Sec. Thirds fourths	Middle Mot. of the Sun in its Orbit.					Motion of Apogæum	
	° ′ ′′ ′′′ ′′′′	′ ′′ ′′′ ′′′′ ′′′′′	′′ ′′′ ′′′′ ′′′′′ ′′′′′′	′′′ ′′′′ ′′′′′ ′′′′′′ ′′′′′′′	′′′′ ′′′′′ ′′′′′′ ′′′′′′′ ′′′′′′′′	′′′ ′′′′ ′′′′′ ′′′′′′ ′′′′′′′	′′′′ ′′′′′ ′′′′′′ ′′′′′′′ ′′′′′′′′		° ′ ′′ ′′′ ′′′′	′ ′′ ′′′ ′′′′ ′′′′′	′′ ′′′ ′′′′ ′′′′′ ′′′′′′	′′′ ′′′′ ′′′′′ ′′′′′′ ′′′′′′′	′′′′ ′′′′′ ′′′′′′ ′′′′′′′ ′′′′′′′′	′′′ ′′′′ ′′′′′ ′′′′′′ ′′′′′′′	′′′′ ′′′′′ ′′′′′′ ′′′′′′′ ′′′′′′′′
1	0	2	27	50	29	0	21	31	1	16	23	4	54	10	36
2	0	4	55	40	58	0	41	32	1	18	50	55	23	10	57
3	0	7	23	31	27	1	2	33	1	21	18	45	52	11	17
4	0	9	51	21	55	1	22	34	1	23	46	36	20	11	38
5	0	12	19	12	24	1	43	35	1	26	14	26	49	11	58
6	0	14	47	2	53	2	3	36	1	28	42	17	18	12	19
7	0	17	14	53	22	2	24	37	1	31	10	7	47	12	39
8	0	19	42	43	51	2	44	38	1	33	37	58	15	13	0
9	0	22	10	34	20	3	5	39	1	36	5	48	44	13	20
10	0	24	38	24	48	3	25	40	1	38	33	39	14	13	41
11	0	27	6	15	17	3	46	41	1	41	1	29	43	14	2
12	0	29	34	5	46	4	6	42	1	43	29	20	12	14	23
13	0	32	1	56	15	4	27	43	1	45	57	10	41	14	43
14	0	34	29	46	43	4	48	44	1	48	25	1	9	15	3
15	0	36	57	37	12	5	8	45	1	50	52	51	38	15	24
16	0	39	25	27	41	5	28	46	1	53	20	42	7	15	45
17	0	41	53	18	10	5	49	47	1	55	48	32	36	16	5
18	0	44	21	8	38	6	10	48	1	58	16	23	4	16	26
19	0	46	48	59	7	6	30	49	2	0	44	13	33	16	46
20	0	49	16	49	37	6	51	50	2	3	12	4	2	17	6
21	0	51	44	40	6	7	11	51	2	5	39	54	31	17	2
22	0	54	12	30	35	7	32	52	2	8	7	45	0	17	48
23	0	56	40	21	4	7	52	53	2	10	35	35	29	18	8
24	0	59	8	11	32	8	13	54	2	13	3	25	57	18	28
25	1	1	36	2	1	8	33	55	2	15	31	16	26	18	49
26	1	4	3	52	30	8	54	56	2	17	59	6	55	19	10
27	1	6	31	42	59	9	14	57	2	20	26	57	24	19	30
28	1	8	59	33	27	9	35	58	2	22	54	47	52	19	51
29	1	11	27	23	56	9	55	59	2	25	22	38	21	20	11
30	1	13	55	14	25	10	16	60	2	27	50	28	51	20	32

FIFTH TABLE.

A TABLE of the Equations, or Proſthaphæreſes of the Sun's Elliptical Orbit.

The Equation is to be ſubſtracted from its correſponding mean Anomaly, denoted by the Number of the Sign on the Top; and by the Degree of that

	Sign	0				1					2					
	°	′	″	‴	⁗	°	′	″	‴	⁗	°	′	″	‴	⁗	
	0	00	00	00	00	0	56	00	45	46	1	37	39	13	49	30
1	0	01	57	06	41	0	57	41	24	58	1	38	36	11	23	29
2	0	03	50	14	02	0	59	22	4	9	1	39	33	8	56	28
3	0	05	49	11	36	1	1	2	43	21	1	40	30	6	30	27
4	0	07	48	09	10	1	2	43	22	33	1	41	27	4	4	26
5	0	09	45	56	02	1	4	20	31	37	1	42	19	31	54	25
6	0	11	41	57	26	1	5	55	2	38	1	43	7	22	58	24
7	0	13	37	58	50	1	7	29	33	38	1	43	55	14	3	23
8	0	15	34	00	14	1	9	4	4	39	1	44	43	5	7	22
9	0	17	30	01	38	1	10	38	35	40	1	45	30	56	12	21
10	0	19	25	37	44	1	12	10	6	18	1	46	13	45	24	20
11	0	21	20	18	04	1	13	38	54	10	1	46	52	11	41	19
12	0	23	14	58	24	1	15	7	42	3	1	47	30	37	59	18
13	0	25	09	38	44	1	16	36	29	55	1	48	9	4	16	17
14	0	27	04	19	05	1	18	5	17	48	1	48	47	30	34	16
15	0	28	57	53	02	1	19	27	57	27	1	49	20	58	28	15
16	0	30	50	06	51	1	20	49	15	3	1	49	49	30	7	14
17	0	32	42	20	40	1	22	10	32	40	1	50	18	1	47	13
18	0	34	34	34	29	1	23	31	50	16	1	50	46	33	26	12
19	0	36	26	48	18	1	24	53	7	53	1	51	15	5	6	11
20	0	38	17	31	33	1	26	10	46	35	1	51	38	37	16	10
21	0	40	8	59	56	1	27	26	14	5	1	51	57	3	48	9
22	0	42	0	28	20	1	28	41	41	34	1	52	15	30	20	8
23	0	43	51	56	43	1	29	57	9	4	1	52	33	56	52	7
24	0	45	43	25	7	1	31	12	36	34	1	52	52	23	24	6
25	0	47	20	28	41	1	32	15	26	54	1	53	5	41	25	5
26	0	49	5	26	26	1	33	21	3	23	1	53	13	9	34	4
27	0	50	50	24	10	1	34	26	39	52	1	53	20	37	43	3
28	0	52	35	21	55	1	35	32	16	22	1	53	28	5	52	2
29	0	54	20	19	40	1	36	37	52	51	1	53	35	34	1	1
30	0	56	0	45	46	1	37	39	13	49	1	53	41	25	22	0
	Sign	11				10					9					

The Equation is to be added to its correſponding mean Anomaly, denoted by the Number of the Sign at

Vth

Vth TABLE.

Sign in the little Column on the Left Hand. The Remainder is the true Anomaly.

[The Eccentricity 31877228.]

[Half of the tranſverſe Axis of the Orbit 1927500000.]

	Sign 3					4					5					
	°	′	″	‴	⁗	°	′	″	‴	⁗	°	′	″	‴	⁗	
0	1	53	41	25	22	1	39	53	23	25	0	58	17	33	10	30
1	1	53	44	3	14	1	38	54	43	9	0	56	33	7	54	29
2	1	53	43	29	7	1	37	51	11	29	0	54	45	41	34	28
3	1	53	41	20	52	1	36	47	39	49	0	52	56	33	36	27
4	1	53	37	56	7	1	35	44	8	9	0	51	7	25	38	26
5	1	53	28	52	4	1	34	40	36	29	0	49	18	17	40	25
6	1	53	19	48	2	1	33	33	14	18	0	47	29	9	42	24
7	1	53	10	43	59	1	32	24	50	43	0	45	49	33	3	23
8	1	53	1	39	57	1	31	16	27	7	0	43	52	15	27	22
9	1	52	47	22	26	1	30	8	3	32	0	41	54	57	51	21
10	1	52	30	58	5	1	28	59	39	57	0	39	57	40	15	20
11	1	52	12	34	7	1	27	26	53	28	0	38	2	42	29	19
12	1	51	48	57	13	1	26	5	59	46	0	36	7	2	4	18
13	1	51	25	20	18	1	24	45	6	4	0	34	9	38	31	17
14	1	51	1	43	24	1	23	24	12	23	0	32	12	14	59	16
15	1	50	38	6	30	1	22	3	18	41	0	30	14	51	26	15
16	1	50	9	9	47	1	20	38	23	48	0	28	17	27	54	14
17	1	49	35	12	23	1	19	9	36	10	0	26	18	35	21	13
18	1	49	1	14	59	1	17	40	48	31	0	24	19	8	26	12
19	1	48	27	17	35	1	16	12	0	53	0	22	14	28	35	11
20	1	47	53	20	11	1	14	43	13	15	0	20	14	46	8	10
21	1	47	13	36	30	1	13	10	43	54	0	18	15	3	41	9
22	1	46	29	42	51	1	11	36	47	10	0	16	15	21	16	8
23	1	45	45	49	11	1	9	59	26	10	0	14	15	38	48	7
24	1	45	1	55	32	1	8	22	5	18	0	12	7	42	24	6
25	1	44	18	1	53	1	6	44	44	22	0	10	7	3	8	5
26	1	43	28	59	43	1	5	7	23	25	0	8	6	23	53	4
27	1	42	35	5	38	1	3	26	44	40	0	6	5	44	37	3
28	1	41	41	11	34	1	1	43	40	50	0	4	5	5	22	2
29	1	40	47	17	29	1	0	0	37	0	0	2	2	33	29	1
30	1	39	53	23	25	0	58	17	33	10	0	0	0	0	0	0
	Sign 8					7					6					

the Bottom; and by the Degree of that Sign in the little Column on the Right Hand.

The Sum is the true Anomaly.

SIXTH

SIXTH TABLE.

A TABLE of the right Aſcenſions of the Sun; The greateſt Declination of the Ecliptick being $= 23° + 28' + 54''$.

[Chap. III. Num. 13.]

Sig.	♈					♉					♊				
	°	′	″	‴	⁗	°	′	″	‴	⁗	°	′	″	‴	⁗
0	0	0	0	0	0	27	54	10	34	36	57	48	37	37	09
1	00	55	01	55	29	28	51	33	16	31	58	51	10	52	55
2	01	50	04	55	08	29	49	04	45	57	59	53	54	13	11
3	02	45	09	43	37	30	46	45	15	09	60	56	47	21	10
4	03	40	10	54	26	31	44	34	57	29	61	59	50	18	11
5	04	35	15	59	46	32	42	34	03	03	63	03	2	40	36
6	05	30	22	44	34	33	40	42	41	52	64	06	24	19	50
7	06	25	31	20	31	34	39	01	07	22	65	69	55	00	14
8	07	20	42	12	41	35	37	29	23	44	66	13	34	27	46
9	08	15	55	35	22	36	36	07	44	56	67	17	22	27	39
10	09	11	11	48	51	37	34	56	17	37	68	21	18	41	08
11	10	06	30	50	26	38	33	55	09	53	69	25	22	53	01
12	11	01	54	03	42	39	33	04	27	51	70	29	34	41	34
13	11	57	20	41	30	40	32	24	17	24	71	33	53	53	05
14	12	52	51	23	54	41	31	54	46	49	72	38	20	02	24
15	13	48	26	28	32	42	31	35	59	18	73	42	52	52	22
16	14	44	6	13	17	43	31	27	58	56	74	47	31	59	46
17	15	39	50	57	32	44	31	30	50	35	75	52	17	05	55
18	16	35	40	55	51	45	31	45	00	00	76	57	07	43	33
19	17	31	36	28	17	46	32	09	15	28	78	02	03	30	44
20	18	27	37	49	03	47	32	44	53	35	79	07	04	03	50
21	19	23	45	16	21	48	33	31	27	14	80	12	08	59	57
22	20	19	59	06	43	49	34	29	00	45	81	17	17	55	59
23	21	16	19	35	26	50	35	37	30	26	82	22	30	23	03
24	22	12	46	58	30	51	36	56	49	35	83	27	45	56	49
25	23	09	21	34	11	52	38	27	01	11	84	33	04	10	19
26	24	6	03	32	53	53	40	07	57	02	85	38	24	37	13
27	25	2	53	13	3	54	41	59	37	13	86	43	46	53	30
28	25	59	50	47	8	55	44	01	50	30	87	49	10	31	46
29	26	56	56	30	13	56	46	14	32	02	88	54	35	14	06
30	27	54	10	34	36	57	48	37	37	09	90	00	00	00	00

VIth

VI^th TABLE.

A TABLE of the right Aſcenſions of the Sun, &c.

Sig.	♋					♌					♍				
	°	′	″	‴	⁗	°	′	″	‴	⁗	°	′	″	‴	⁗
0	90	00	00	00	00	122	11	22	22	51	152	05	49	25	24
1	91	05	24	45	54	123	13	45	27	58	153	03	03	29	47
2	92	10	49	28	14	124	15	58	09	30	154	00	09	12	52
3	93	16	13	6	30	125	18	00	22	47	154	57	06	46	57
4	94	21	35	22	47	126	19	52	02	58	155	53	56	27	07
5	95	26	55	49	41	127	21	32	58	49	156	50	38	25	49
6	96	32	14	03	11	128	23	03	10	25	157	47	13	01	30
7	97	37	29	36	57	129	24	22	29	34	158	43	40	24	34
8	98	42	42	04	01	130	25	30	59	15	159	40	00	53	17
9	99	47	51	00	03	131	26	28	32	46	160	36	14	43	39
10	100	52	55	56	10	132	27	15	06	25	161	32	22	10	57
11	101	57	56	29	16	133	27	50	44	32	162	28	23	31	43
12	103	02	52	16	27	134	28	15	00	00	163	24	19	04	09
13	104	07	42	54	05	135	28	29	09	25	164	20	09	02	28
14	105	12	28	00	14	136	28	32	01	04	165	15	53	46	43
15	106	17	07	07	38	137	28	24	00	42	166	11	33	31	28
16	107	21	39	57	36	138	28	05	13	11	167	07	08	36	06
17	108	26	06	06	55	139	27	35	42	36	168	02	39	18	30
18	109	30	25	18	26	140	26	55	32	09	168	58	05	56	18
19	110	34	37	06	59	141	26	4	50	07	169	53	29	09	34
20	111	38	41	18	52	142	25	3	42	23	170	48	48	11	09
21	112	42	37	32	21	143	23	52	15	04	171	44	04	24	38
22	113	46	25	32	14	144	22	30	36	16	172	39	17	47	19
23	114	50	4	59	46	145	20	58	52	38	173	34	28	39	29
24	115	53	35	40	10	146	19	17	18	08	174	29	37	15	26
25	116	56	57	19	24	147	17	25	56	57	175	24	44	00	14
26	118	00	09	41	49	148	15	25	02	31	176	19	49	05	34
27	119	03	12	38	44	149	13	14	44	51	177	14	50	16	23
28	120	06	05	46	49	150	10	55	14	03	178	09	55	04	52
29	121	08	49	07	05	151	08	26	43	29	179	04	58	04	31
30	122	11	22	22	51	152	05	49	25	24	180	00	00	00	00

VI^th TABLE.

A TABLE of the right Aſcenſions of the Sun, &c.

Si.	♎					♏					♐				
	°	′	″	‴	⁗	°	′	″	‴	⁗	°	′	″	‴	⁗
0°	180	0	0	0	0	207	54	10	34	36	237	48	37	37	9
1	180	55	1	55	29	208	51	33	16	31	238	51	10	52	55
2	181	50	4	55	8	209	49	4	45	57	239	53	54	13	11
3	182	45	9	43	37	210	46	45	15	9	240	56	47	21	10
4	183	40	10	54	26	211	44	34	57	29	241	59	50	18	11
5	184	35	15	59	46	212	42	34	3	3	243	3	2	40	36
6	185	30	22	44	34	213	40	42	41	52	244	6	24	19	50
7	186	25	31	20	31	214	39	1	7	22	245	9	55	0	14
8	187	20	42	12	41	215	37	29	23	44	246	13	34	27	46
9	188	15	55	35	22	216	36	7	44	56	247	17	22	27	39
10	189	11	11	48	51	217	34	56	17	37	248	21	18	41	8
11	190	6	30	50	26	218	33	55	9	53	249	25	22	53	1
12	191	1	54	3	42	219	33	4	27	51	250	29	34	41	34
13	191	57	20	41	30	220	32	24	17	24	251	33	53	53	5
14	192	52	51	23	54	221	31	54	46	49	252	38	20	2	24
15	193	48	26	28	32	222	31	35	59	16	253	42	52	52	22
16	194	44	6	13	17	223	31	27	58	56	254	47	31	59	46
17	195	39	50	57	32	224	31	30	50	35	255	52	17	5	55
18	196	35	40	55	51	225	31	45	0	0	256	57	7	43	33
19	197	31	36	28	17	226	32	9	15	28	258	2	3	30	44
20	198	27	37	49	3	227	32	44	53	35	259	7	4	3	50
21	199	23	45	16	21	238	33	31	27	14	260	12	8	59	57
22	200	19	59	6	43	239	34	29	0	45	261	17	17	55	59
23	201	16	19	35	26	230	35	37	30	26	262	22	30	23	3
24	202	12	46	58	30	231	36	56	49	34	263	27	45	56	49
25	203	9	21	34	11	232	38	27	1	11	264	33	4	10	19
26	204	6	3	32	53	233	40	7	57	2	265	38	24	37	13
27	205	2	53	13	3	234	41	59	37	13	266	43	46	53	30
28	205	59	50	47	8	235	44	1	50	30	267	49	10	31	46
29	206	56	56	30	13	236	46	14	32	2	268	54	35	14	6
30	207	54	10	34	26	227	48	37	37	9	70	0	0	0	0

VIth TABLE.

A TABLE of the right Aſcenſions of the Sun &c.

Si.	♑					♒					♓				
	°	′	″	‴	⁗	°	′	″	‴	⁗	°	′	″	‴	⁗
0	270	00	00	00	00	302	11	22	22	51	332	5	49	25	24
1	271	5	24	45	54	303	13	45	27	58	333	3	3	29	47
2	272	10	49	28	14	304	15	58	9	30	334	0	9	12	52
3	273	16	13	6	30	305	18	0	22	47	334	57	6	46	57
4	274	21	35	22	47	306	19	52	2	58	335	53	56	27	7
5	275	26	55	49	41	307	21	32	58	49	336	50	38	25	49
6	276	32	14	3	11	308	23	3	10	25	337	47	13	1	30
7	277	37	29	36	57	309	24	22	29	34	338	43	40	24	34
8	278	42	42	4	1	310	25	30	59	15	339	40	0	53	17
9	279	47	51	0	3	311	26	28	32	46	340	36	14	43	39
10	280	52	55	56	10	312	27	15	6	25	341	32	22	10	57
11	281	57	56	29	16	313	27	50	44	32	342	28	23	31	43
12	283	2	52	16	27	314	28	15	0	0	343	24	19	4	9
13	284	7	42	54	5	315	28	29	9	25	344	20	9	2	28
14	285	12	28	0	14	316	28	32	1	4	345	15	53	46	42
15	286	17	7	7	38	317	28	24	0	42	346	11	33	31	28
16	287	21	39	57	36	318	28	5	13	11	347	7	8	36	6
17	288	26	6	6	55	319	27	35	42	36	348	2	39	18	30
18	289	30	25	18	26	320	26	55	32	9	348	58	5	56	18
19	290	34	37	6	59	321	26	4	50	7	349	53	29	9	34
20	291	38	41	18	52	322	25	3	42	23	350	48	48	11	9
21	292	42	37	32	21	323	23	52	15	4	351	44	4	24	38
22	293	46	25	32	14	324	22	30	36	16	352	39	17	47	19
23	294	50	4	59	46	325	20	58	52	38	353	34	28	39	9
24	295	53	35	40	10	326	19	17	18	8	354	29	37	15	26
25	296	56	57	19	24	327	17	25	56	57	355	24	44	0	14
26	298	0	9	41	49	328	15	25	2	31	356	19	49	5	34
27	299	3	12	38	44	329	13	14	44	51	357	14	50	16	23
28	300	6	5	46	49	330	10	55	14	3	358	9	55	4	52
29	301	8	49	7	5	331	8	26	43	29	359	4	58	4	31
30	302	11	22	22	51	332	5	49	25	24	360	0	0	0	0

SEVENTH TABLE.

A TABLE of the equal Time taken up whilſt the Arches of the Equinoctial Circle move under the Semimeridian of G, *by the Diurnal Motion.*

Whilſt Arch of Equinox moves under the Semimeridian of G.	Equal Time taken up					Whilſt Arch of Equinox moves under the Semimeridian of *G*.	Equal Time taken up				
Degrees 1ſt Scruples 2d Scruples 3d Scruples 4th Scruples	Hou. ' '' ''' ''''	' '' ''' '''' '''''	'' ''' '''' ''''' ''''''	''' '''' ''''' '''''' '''''''	'''' ''''' '''''' ''''''' ''''''''	Degrees 1ſt Scruples 2d Scruples 3d Scruples 4th Scruples	Hours ' '' ''' ''''	' '' ''' '''' '''''	'' ''' '''' ''''' ''''''	''' '''' ''''' '''''' '''''''	'''' ''''' '''''' ''''''' ''''''''
1	0	3	59	20	41	31	2	3	39	41	8
2	0	7	58	41	22	32	2	7	39	1	49
3	0	11	58	2	3	33	2	11	38	22	30
4	0	15	57	22	44	34	2	15	37	43	11
5	0	19	56	43	25	35	2	19	37	3	52
6	0	23	56	4	5	36	2	23	36	24	33
7	0	27	55	24	46	37	2	27	35	45	13
8	0	31	54	45	27	38	2	31	35	5	54
9	0	35	54	6	8	39	2	35	34	26	5
10	0	39	53	26	49	40	2	39	33	47	16
11	0	43	52	47	30	41	2	43	33	7	57
12	0	47	52	8	11	42	2	47	32	28	38
13	0	51	51	28	52	43	2	51	31	49	19
14	0	55	50	49	33	44	2	55	31	10	0
15	0	59	50	10	14	45	2	59	30	30	41
16	1	3	49	30	55	46	3	3	29	51	22
17	1	7	48	51	35	47	3	7	29	12	2
18	1	11	48	12	16	48	3	11	28	32	43
19	1	15	47	32	57	49	3	15	27	53	24
20	1	19	46	53	38	50	3	19	27	14	5
21	1	23	46	14	19	51	3	23	26	34	46
22	1	27	45	35	0	52	3	27	25	55	27
23	1	31	44	55	41	53	3	31	25	16	8
24	1	35	44	16	22	54	3	35	24	36	49
25	1	39	43	37	3	55	3	39	23	57	30
26	1	43	42	57	44	56	3	43	23	18	11
27	1	47	42	18	24	57	3	47	22	38	51
28	1	51	41	39	5	58	3	51	21	59	32
29	1	55	40	59	46	59	3	55	21	20	13
30	1	59	40	20	27	60	3	59	20	40	54

EIGHTH

EIGHTH TABLE.

A TABLE, wherein Degrees and Hours, 1st Scruples and Minutes, 2d Scruples and Seconds, 3d Scruples and Thirds, are reduced to 4th Scruples and Fourths.

Deg. Ho.	Fourths ''''	Deg. Ho.	Fourths. ''''	Min. '	Fou. ''''	Min. '	Fou. ''''
1=	12960000	31=	401760000	1=	216000	31=	6996000
2=	25920000	32=	414720000	2=	432000	32=	6912000
3=	38880000	33=	427680000	3=	648000	33=	7128000
4=	51840000	34=	440640000	4=	864000	34=	7344000
5=	64800000	35=	453600000	5=	1080000	35=	7560000
6=	77760000	36=	466560000	6=	1296000	36=	7776000
7=	90720000	37=	479520000	7=	1512000	37=	7992000
8=	103680000	38=	492480000	8=	2728000	38=	8208000
9=	116640000	39=	505440000	9=	1944000	39=	8424000
10=	129600000	40=	518400000	10=	2160000	40=	8640000
11=	142560000	41=	531360000	11=	2376000	41=	8856000
12=	155520000	42=	544320000	12=	2592000	42=	9072000
13=	168480000	43=	557280000	13=	2808000	43=	9288000
14=	181440000	44=	570240000	14=	3024000	44=	9504000
15=	194400000	45=	583200000	15=	3240000	45=	9720000
16=	207360000	46=	596160000	16=	3456000	46=	9936000
17=	220320000	47=	609120000	17=	3672000	47=	10152000
18=	233280000	48=	622080000	18=	3888000	48=	10368000
19=	246240000	49=	635040000	19=	4104000	49=	10584000
20=	259200000	50=	648000000	20=	4320000	50=	10 00000
21=	272160000	51=	660960000	21=	4536000	51=	11016000
22=	285120000	52=	673920000	22=	4752000	52=	11232000
23=	298080000	53=	686880000	23=	4968000	53=	11448000
24=	311040000	54=	699840000	24=	5184000	54=	11664000
25=	324000000	55=	712800000	25=	5400000	55=	11880000
26=	336960000	56=	725760000	26=	5616000	56=	12096000
27=	349920000	57=	738720000	27=	5832000	57=	12312000
28=	362880000	58=	751680000	28=	6048000	58=	12528000
29=	375840000	59=	764640000	29=	6264000	59=	12744000
30=	388800000	60=	777600000	30=	6480000	60=	12960000

VIIIth TABLE.

A TABLE, wherein Degrees and Hours, 1ſt Scruples and Minutes, 2d Scruples and Seconds, and 3d Scruples and Thirds are reduced to 4th Scruples and Fourths.

Sec.	Fou.	Sec.	Fou.	Th.	Fou.	Th.	Fou.
″	⁗	″	⁗	‴	⁗	‴	⁗
1=	3600	31=	111600	1=	60	31=	1860
2=	7200	32=	115200	2=	120	32=	1920
3=	10800	33=	118800	3=	180	33=	1980
4=	14400	34=	122400	4=	240	34=	2040
5=	18000	35=	126000	5=	300	35=	2100
6=	21600	36=	129600	6=	360	36=	2160
7=	25200	37=	133200	7=	420	37=	2220
8=	28800	38=	136800	8=	480	38=	2280
9=	32400	39=	140400	9=	540	39=	2340
10=	36000	40=	144000	10=	600	40=	2400
11=	39600	41=	147600	11=	660	41=	2460
12=	43200	42=	151200	12=	720	42=	2520
13=	46800	43=	154800	13=	780	43=	2580
14=	50400	44=	158400	14=	840	44=	2640
15=	54000	45=	162000	15=	900	45=	2700
16=	57600	46=	165600	16=	960	46=	2760
17=	61200	47=	169200	17=	1020	47=	2820
18=	64800	48=	172800	18=	1080	48=	2880
19=	68400	49=	176400	19=	1140	49=	2940
20=	72000	50=	180000	20=	1200	50=	3000
21=	75600	51=	183600	21=	1260	51=	3060
22=	79200	52=	187200	22=	1320	52=	3120
23=	82800	53=	190800	23=	1380	53=	3180
24=	86400	54=	194400	24=	1440	54=	3240
25=	90000	55=	198000	25=	1500	55=	3300
26=	93600	56=	201600	26=	1560	56=	3360
27=	97200	57=	205200	27=	1620	57=	3420
28=	100800	58=	208800	28=	1680	58=	3480
29=	104400	59=	212400	29=	1740	59=	3540
30=	108000	60=	216000	30=	1800	60=	3600

1296x			36x		
1	=	1296	1	=	36
2	=	2592	2	=	72
3	=	3888	3	=	108
4	=	5184	4	=	144
5	=	6480	5	=	180
6	=	7776	6	=	216
7	=	9072	7	=	252
8	=	10368	8	=	288
9	=	11664	9	=	324

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Advertiſement,

To thoſe who have Obſervatories, and who are accuſtomed to obſerve the Diſtances of Stars with large Inſtruments, accurately divided into Seconds.

IN Mr. *Flamſteed*'s *Britannick* Catalogue of unerring Stars, in the 3d Volume of his *Britannick* Hiſtory of the Heavens, I find,

In Conſtellatione Ceti, Pag. 25. Lin. 42.

Ordo.		Stellarum Denominatio.	Bay. Ch.	Aſcenſio recta.	Diſtantia a Polo B.	♉ Longitudo.	Latitudo.	Magnit.
Ptol.	Tych.							
2	2	Trium in roſtro ſequens in extrema maxilla.	α	41°+31′+50″	87°+09′+35″	09°+59′+15″	A 12°+36′+59″	2

ADVERTISEMENT.

In Conſtellatione Arietis, Pag. 1. Lin. 13.

Inf. 1.		Inform. ſuper caput Lucida Arietis.	α	Aſcenſio recta. 27°+26′+30′	Diſtantia a Polo B 68°+1′+45″

Longit. ♉	Latitud. B.	Magnit.
03°+19′+18″	9°+57′+12″	2

I deſire, that two Obſervations of the Diſtances of thoſe two Stars from each other may be made with the greateſt Exactneſs, when the Sun is come in its annual Courſe to 15° of ♐, or thereabout.

I would have the firſt Obſervation made when the Star called *Trium in roſtro ſequens in extrema maxilla* is elevated about 4° above the ſenſible Horizon.

And I would have the Second Obſervation made the ſame Night afterwards, or within few Nights afterwards, when the Star called *Inform. ſupra Caput Lucida Arietis* is elevated ſo high as be brought nearly to the Meridian.

And at each of theſe two Obſervations I would have the Elevation of thoſe Stars obſerved as nicely as may be.

The Time of Year for obſerving theſe Things, is about the 26th of *November*.

Again:

In Conſtellatione Orionis, Pag. 28. Lin. 21.

Ordo.		Stellarum Denominatio.	Bay. ch.	Aſcenſio recta.	Diſtantia a Polo B.
Ptol.	Tych.				
26	28	Trium in Cingulo Præcedens	δ	79°+02′+30′	90°+34′+25″

Longitudo.	Latitudo.	Magnit.
♊ 18°+01′+38″	A 23°+36′+07′	2

In Conſtellatione Tauri, Pag. 4. Lin. 36.

Ordo.		Stellarum Denominatio.	Bay. ch.	Aſcenſio recta.	Diſtantia a Polo B.
14	14	Splendida in Auſtrino oculo Palilicium Aldebaran.	α	64°+32′+20″	74°+09′+40″

Longitudo.	Latitudo.	Magnit.
♊ 05°+27′+00″	A 05°+29′+49″	1

I deſire, that Two Obſervations of the Diſtances of thoſe Two Stars from each other may be made with the greateſt Exactneſs, when the

Sun is come in its annual Courſe to 20° of ♑, or thereabout.

I would have the Firſt Obſervation made when the Star called *Trium in cingulo præcedens* is elevated about four or five Degrees above the ſenſible Horizon.

And I would have the Second Obſervation made the ſame Night afterwards, or within few Nights afterwards, when the Star called *Aldebaran* is nearly brought, by the diurnal Motion, to the Meridian.

And at each of theſe Two Obſervations I would have the Elevation of thoſe Stars obſerved as nicely as may be.

The Time of Year for obſerving thoſe Things is about the 31ſt of *December*.

If the Obſervations of either Pair of theſe Stars be accurately made, and tranſmitted to me, or made publick, I am perſuaded I could from thence draw ſome Concluſion which might be of Service to Aſtronomy.

FINIS.

BIBLIOTHECA BODLEIANA